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FOREWORD

Ordnance Pamphlet NAVWEPS OP 2210, Volume 1, Revision1, catalogs the types of aircraft rocket components and launchers and gives the assembly and disassembly procedures for these rockets and launchers. Volume 2 of this ordnance pamphlet presents logistics and depot and shipboard operations for ZUNI, 5.0-inch general purpose, folding-fin aircraft rocket.

This publication is intended for use by trained personnel who are authorized to handle Navy rockets designed for firing from aircraft. It provides them with specific information including description, identification, assembly, and use of aircraft rockets.

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SAFETY SUMMARY

GENERAL PRECAUTIONS

1. The Bureau of Naval Weapons shall be informed of any circumstances which conflict with safety precautions or which, for any reason, require changes in or additions to them.

2. When in doubt as to the exact meaning of a safety precaution, an interpretation shall be requested from the Bureau of Naval Weapons.

3. Do not make changes in or additions to rocket ammunition, components, or accessories without explicit authority from the Bureau of Naval Weapons.

4. No ammunition or explosive assembly shall be used in any rocket launcher for which it is not designated.

5. No ammunition other than dummy drill shall be used for drill.

6. Particular caution shall be exercised during handling of rocket motors or assembled rockets to avoid propellant grain damage or fracture, Cracks or breaks in the grain increase the carefully calculated burning area and cause excessive internal pressure buildup, which may result in erratic motor performance.

PRECAUTIONS FOR SETBACK-AND-AIR-TRAVEL-ARMING, IMPACT-FIRING NOSE FUZES

1. If the fuze is armed, whether assembled in the rocket warhead or not, no attempt should be made to unarm it. If the fuze is armed, turning the propeller counterclockwise, as viewed from the nose, will cause the firing pin to pierce the detonator and set off the explosive train.

2. The fuze is safe as long as the cap assembly is held in place by the safety wire or the arming wire. If the cap assembly comes off by accident, the fuze is still safe as long as the propeller is engaged by the propeller locking pin. This can be determined by visual inspection. The fuze shall be considered armed if the propeller is out of engagement with the propeller locking pin and is free to rotate.

3. Armed fuzes must not be fired from rocket launchers.

4. If the fuze in an assembled round is armed inadvertently, the propeller should be carefully taped to prevent

further rotation. The fuze then should be carefully unscrewed from the rocket, taking care not to drop the fuzed round or the fuze on its nose, or strike the fuze in any way. If possible this work should be done by explosive ordnance disposal personnel. If none is available, disposal should be as instructed by the officer in charge.

PRECAUTIONS FOR PRESSURE-ARMING, IMPACT-FIRING BASE FUZES

If, for any reason, it is thought that the fuze may be armed, it should be treated as a hazardous item and disposed of accordingly. No attempt should be made to remove the fuze from the warhead.

SAFETY PRECAUTIONS FOR ACCELERATION-ARMING, POINT-DETONATING NOSE FUZES

1. Acceleration-arming, point-detonating nose fuzes which are damaged should be considered hazardous items and disposed of accordingly.

2. Fuzes found corroded should be returned to an ammunition depot in the rocket warhead in which they are issued.

3. Removal of fuzes from their warheads is not permitted except at ammunition depots unless there is specific authorization.

4. Fuzes in rockets which have been fired are armed. Since all the arming mechanism is inside the fuze, there is no method of determining visually whether the fuze is armed or unarmed.

PRECAUTIONS FOR DECELERATION-DISCRIMINATING BASE FUZES

If an extremely light impact has occurred after the forces of gas pressure, spring, and creep have had their effect, the fuze may be fired by an additional slight jar. A fuze which remains unfired after heavy impact also is very sensitive, since it may be expected that the firing pin has struck the detonator, and subsequent friction between the firing pin and detonator may fire the fuze. In any event, the fuze or fuzed round should be considered hazardous and disposed of accordingly.

PRECAUTIONS IN ASSEMBLING COMPLETE ROUNDS

Do not assemble or fuze rockets until just before the plane is ready to be armed. If this is not practicable, assemble them as near to this time as is feasible.

Do not assemble a high-explosive loaded rocket warhead to a motor without first making sure that the base fuze hole has a base fuze installed and gas-checked, or a properly designed and Bureau-approved steel base plug installed and gas-checked, as in the case of AP/ASW Warhead Mk 29.

PRECAUTIONS FOR AIRCRAFT ROCKET LAUNCHER PACKAGES

1. Make certain rocket warheads are securely attached to motors before installing the rocket in the launcher.

2. Check each rocket for detent locking.

3. Check the ignition contact made between ground fingers (contact points) and rocket fin-retainer contact button.

4. Conduct all steps in a RADHAZ protected area.

5. Check frangible fairings for proper latching. NEVER lift launcher by fairings.

6. Never connect a launcher to the aircraft without first making a stray voltage check.

7. Arm the launcher just before aircraft takeoff.

8. Never suspend launcher from bomb rack not having independent rocket firing and bomb circuits.

PRECAUTIONS DURING ASSEMBLY

1. Do not remove the fuze safety wires or clip.

2. Do not remove the shorting clip from the electrical connector.

3. Do not stand the assembled round on either end.

4. Protect the fins from damage during and after assembly.

PRECAUTIONS DURING DISASSEMBLY

1. It is important that the fuze wrench designed for use with any particular fuze be used to remove the fuze from the round. Use of an improper wrench may engage the wrong holes, flats, or slots, and result in arming the fuze.

2. If a fuze adapter becomes loose while removing the fuze, stop the operation. This is a defective round and is not to be repaired aboard ship. If grains of explosive are

lodged between the adapter threads and warhead threads, unscrewing of the adapter may pinch and initiate the explosive.

3. Do not remove base fuzes, base plates, or nose fuze adapters from rocket warheads at any time.

4. No disassembly of rocket motors is authorized.

5. Fuzes or firing mechanisms for rockets shall not be removed (except nose fuzes), disassembled, repaired, or in any way altered except as provided by special instructions from the Bureau of Naval Weapons.

6. Upon removal of components from the round, inspection of those parts of the components which could not be inspected when the round was assembled must be made before the components can be returned to stowage.

PRECAUTIONS IN HANDLING

1. Handle all components as little as possible.

2. Instruct personnel who will be involved in the handling as to the nature of the material. Only those men essential for handling should be in the area.

3. Personnel working with chemical rockets should have at hand protective gear. When entering concentrated smoke clouds produced by smoke rockets, men should wear gas masks.

4. No disassembly of basic rocket components is authorized except under instructions from the Bureau of Naval Weapons. This applies to warheads, motors, and fuzes.

5. Do not use a circuit continuity tester to check the igniter circuit in a motor aboard ship. The circuit is checked before the motor is placed on board.

6. If dropped from a height exceeding 5 feet, a fuzed rocket warhead (whether or not in a container) shall be returned to an ammunition depot. If return to a depot is not practicable, dispose of the warhead.

7. If a motor is dropped and any portion impacts after falling 18 inches or more, do not use. If convenient, return the motor to the issuing activity with a tag showing pertinent information.

STOWAGE PRECAUTIONS

1. Rocket warheads for which fuzes are issued separately shall not be stowed with those fuzes installed in or near magazines containing explosives.

2. Electrically fired rocket motors, and electric or electronic fuzes shall not be stowed in the same compartment with, or be exposed within 5 feet of, any exposed electronic transmitting apparatus or exposed antenna leads.

3. Matches, naked lights, flame producing devices, or any open flame is forbidden in the vicinity of rocket stowage.

4. Rockets containing pyrotechnic material, such as a flare or an incendiary mixture, shall be stowed in regular pyrotechnic stowage spaces, if such are provided, or in pyrotechnic lockers on upper decks.

5. Nothing shall be stowed in rocket ammunition magazines except rocket ammunition, its containers, and authorized magazine equipment. No oily rags, waste, or material susceptible to spontaneous combustion shall be stowed in these spaces.

6. Remove all rocket explosive components from a magazine before work which might cause an abnormally high temperature or an intense local heat is undertaken.

7. Rockets should be kept in the shade, away from direct sunlight, to avoid raising their propellant temperature above the prescribed safe limit.

8. Observe RADHAZ safety procedures with regards to the hazards of electro-magnetic radiation to both ordnance and personnel as outlined in the Radio-Frequency Hazards Manual NAVWEPS 16-1-529 (latest revision).

PRECAUTION DURING INSPECTION

Do not attempt in any manner to clean a fuze cavity which does not have a cavity liner.

PRECAUTIONS FOR DISPOSAL OF MISFIRES

1. A 10-minute interval is to elapse between the last attempt at firing the round and any attempt to remove the round from the launcher. The plane should be pointed in the safest direction possible.

2. Do not test the launcher firing circuit until all rockets have been removed from the plane.

PRECAUTIONS FOR OVERTAKING OWN ROCKETS

High-speed aircraft can overtake their own rockets under some conditions. The vertical separation of the aircraft and the rockets at the time of overtaking is primarily a function of the aircraft maneuver after firing. Thus, if

the aircraft continues in the same vertical plane after firing and reduces the angle of climb, or steepens the dive angle and increases speed, or does any combination of these things that will make the vertical drop match that of the rockets, the aircraft can overtake and collide with the rocket as illustrated by figure I. The chances of a collision will increase with the number of rockets fired in a salvo because of the normal dispersion. The time required to overtake the rockets is shown in figure II through V for various flight angles, calibrated airspeeds, and altitudes, assuming that the horizontal component of the true airspeed remains constant after firing and that the rockets have normal, stable flight. The curves of figure III, IV, and V begin at the altitudes below which the aircraft cannot overtake the rockets before they reach 0 altitude.

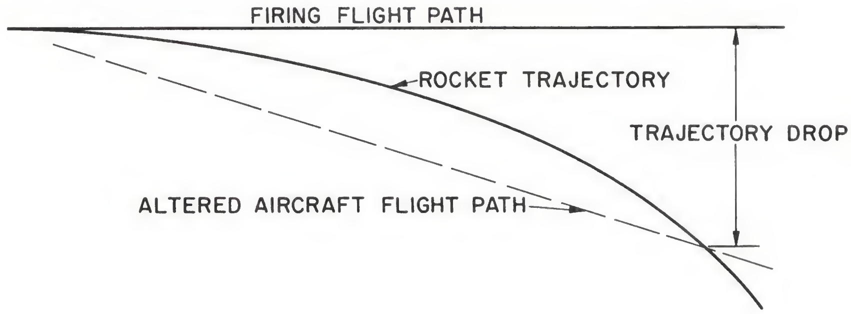


Figure I. Potential Aircraft and Rocket Collision Course.

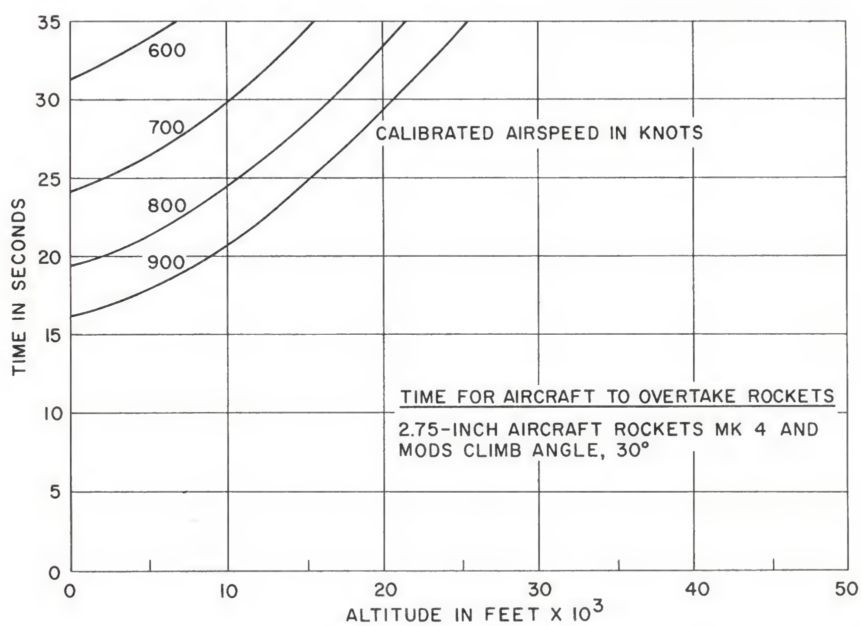


Figure II. Time for Aircraft to Overtake Rockets, Climb Angle, 30°.

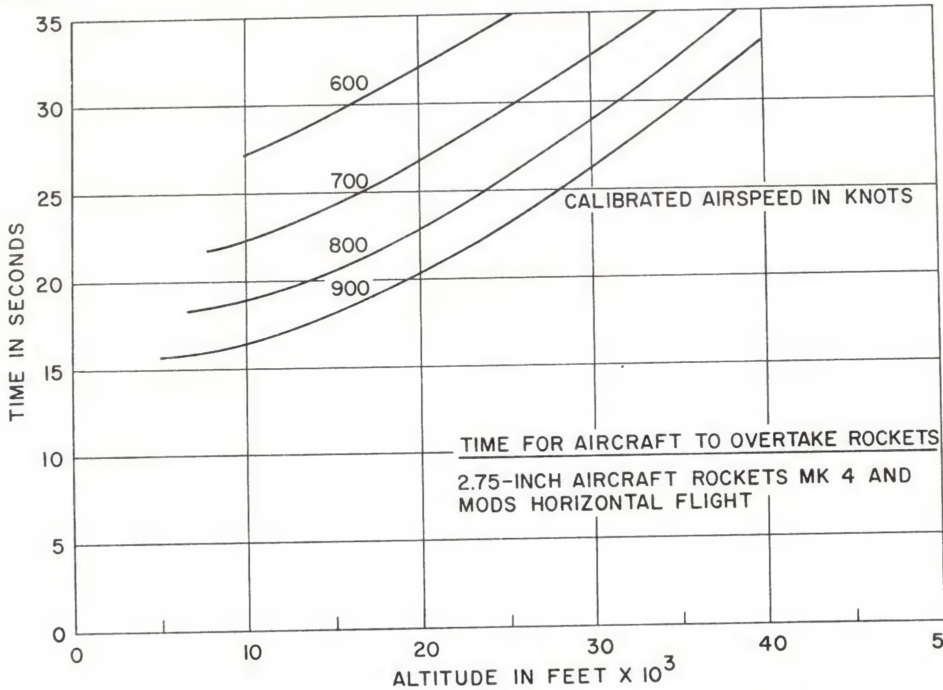


Figure III. Time for Aircraft to Overtake Rockets, Horizontal Flight.

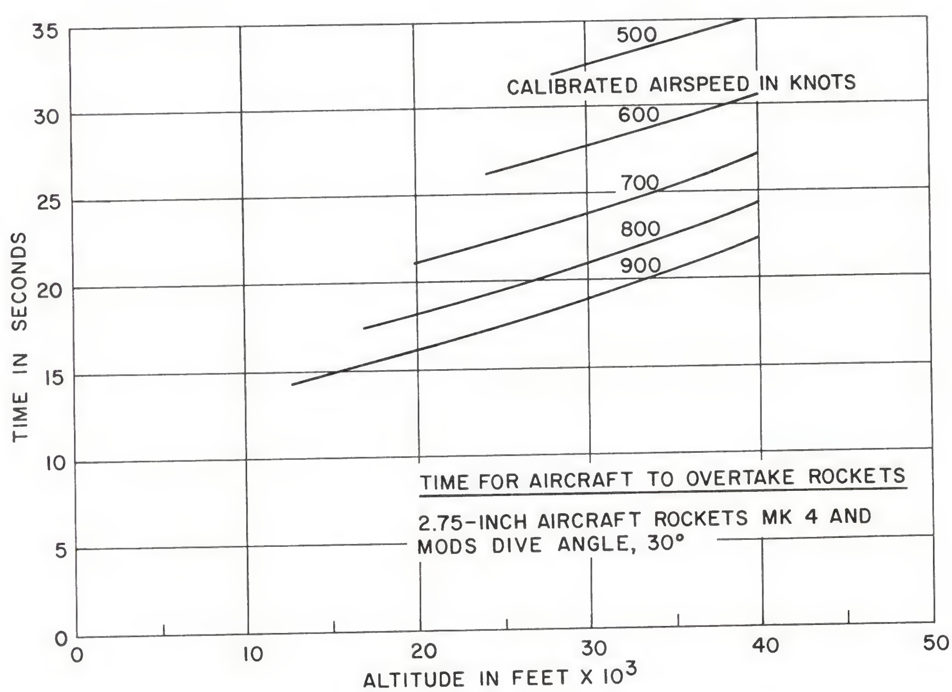


Figure IV. Time for Aircraft to Overtake Rockets, Dive Angle 30°.

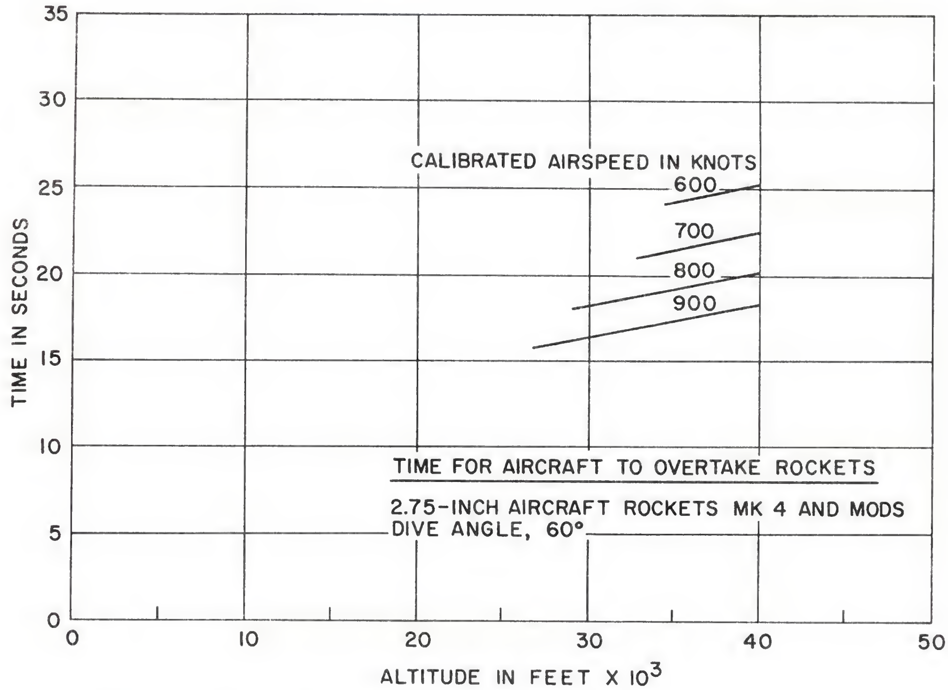


Figure V. Time for Aircraft to Overtake Rockets, Dive Angle, 60° .

To minimize the danger of overtaking 2.75-inch rockets in air firing, the following precautions should be observed:

1. Always change course or pull up within the time shown in the figures after the first rockets are fired.

2. Do not continue course and steepen dive (or reduce climb) after firing.

The following WARNINGS are repeated from the text for the protection of personnel:

WARNING

Do not attempt in any manner to clean a fuze cavity which does not have a cavity liner. (Page 1-40)

A 10-minute interval is to elapse between the last attempt at firing the round and any attempt to remove the round from the launcher. During this period the plane should be pointed in the safest direction possible. (Page 1-45)

Do not test the launcher firing circuit until all rockets have been removed from the aircraft. (Page 1-45)

No attempt should be made to remove the base fuze except by qualified bomb-disposal personnel. The Mk 191 base fuze and gas check gasket are used with every live loaded head. If base fuze hole is uncovered or has any other plug or cover, the head shall not be used, but will be returned to the nearest NAD. Base fuze hole in Mk 24 Mod 0 plaster filled PRACTICE head must be plugged with Base Fuze Hole Plug, Piece No. 457600. This piece is indent stamped "FOR INERT LOADED HEADS ONLY." If this piece is not in place, Mk 24 head will NOT be used, but will be returned to nearest NAD. Failure to comply with these directions can result in premature detonation of the head with attendant loss of life and material. (Page 6-8)

When removing motors from the shipper-launcher, conduct the steps in a RADHAZ safe area. (Page 7-5)

When installing rocket warhead to motor, conduct installation in a RADHAZ safe area. (Page 7-6)

When loading rocket into launcher, conduct steps in a RADHAZ safe area. (Page 7-6)

Stand to the side of the launcher when connecting ignition cable in case inadvertent ignition should occur. (Page 7-8)

The LAU-32A/A launcher must have a 5-ohm, 10-watt, resistor in the firing circuit. (Page 7-12)

The armament switch on the aircraft must be in the OFF position and the detent pin must be in the safety switch when attaching the launcher to the aircraft. (Page 7-12)

When unloading the launcher, conduct all steps in a RADHAZ safe areas. (Page 7-14)

For the LAU-3A/A launcher, a 5-ohm, 10-watt, resistor must be in series with the launcher. Failure to install this resistor will result in salvo of all rockets and possible damage to the aircraft. (Page 7-18)

Make sure spring clips are firmly engaged with the shock pans before manually handling the

LAU-32A/A launcher. Failure to do so may result in serious injury to personnel. (Page 7-21)

Failure to lock the launcher fairing into proper position will cause loss of the fairing band at firing, which will endanger the aircraft and pilot. (Page 7-22)

When arming the aircraft before takeoff, inspect the Aero-7D launcher receptacle to make sure that the line holding the shorting button did not break, leaving the launcher shorted. (Page 7-22)

When unloading the launcher, perform all steps in RADHAZ safe area. (Page 7-23

When preparing new LAU-10/A launchers for use, perform all steps in a RADHAZ safe area. (Page 7-28)

Before lowering the detent to FIRE position when preparing the LAU-10/A launcher for use, remove all rounds from the launcher. (Page 7-28)

Detents must be properly positioned in order to fire rockets or to hold them in the launcher during rough handling. (Page 7-29)

Never touch the contact band or remove the shielding band before loading the rocket into the launcher tube of the LAU-10/A launcher. Radio frequency energy may be present and could cause accidental ignition of the rocket motor. (Page 7-30)

Do not drop the launcher when removing it from the bomb rack. (Page 7-32)

Safety pin installed in Aero 3A missile launcher does not interrupt firing circuits of LAU-33/A or LAU-35/A launchers. Rocket firing circuits are safe only after safety pin (BuOrd 58A164C165) has been inserted. Safety pins that do not have a ball-lock shall not be used, because without the ball retention the pins might fall out. (Pages 7-36 and 7-37)

The following CAUTIONS are repeated from the text because if not strictly followed the effectiveness of the equipment or rocket may be destroyed.

CAUTIONS

Do not attempt under any circumstances to use a warhead that does not have its base fuze hole

closed and gas-checked. Base fuze holes must be gas-checked regardless of whether a base fuze or a steel base fuze hole plug is used, as in the case of Warhead Mk 29 Mod 0. (Page 1-40)

Do not pull the lockwire tab down and out of the elongated hole into the motor tube lockwire groove. The enlarged tab traveling through the lockwire groove will bulge the motor tube, making it unsafe to fire. Any motors with the lockwire tabs displaced either by turning in or out of the elongated groove should be discarded as unserviceable. If a gap exists between the forward end of the motor and the warhead after assembly, discard the rocket as unserviceable. (Page 6-2)

The fin protector contains a spring that serves to short-circuit the igniter leads. (Pages 6-2 and 6-3)

If a gap exists between the forward end of the motor and the warhead after assembly, discard the rocket as unserviceable. (Page 6-3)

Detents shall not be checked by hand if launcher is on the aircraft or in a RADHAZ area. Check below deck is practicable. If it becomes necessary to check on flight deck, observe provisions of BuShips Message 232230Z May 1958. Use a nonconductive plastic rod 12 inches or more in length to push rockets. (Page 6-4)

Do not remove the shorting clip on the electrical connector plug unit.(Page 6-6)

DO NOT USE FAHNESTOCK CLIPS. They might foul the arming vanes. Sufficient tension is provided by the arming pin spring to hold the arming wire securely in place. (Page 6-6)

Bending the fingers of the ignition spider carelessly or too far could damage the ignition spider. (Page 7-6)

Do not overtighten sway braces as the rockets will be trapped in the launcher tubes by the deformation of the launcher bulkhead. (Page 7-7)

The fairings are easily damaged if handled roughly, do not drop, squeeze, or strike unprotected fairings. (Page 7-8)

Do not press on fairing nose or push sideways. (Page 7-8)

Launcher must be in horizontal position for loading. Rocket warheads must be attached to rocket motors before installing in launcher. (Pages 7-11 and 7-19)

To prevent damage, do not ram rocket against detent. Slide gently into place. (Page 7-11 and 7-19)

When attaching the launcher to the aircraft and the forward striker post is used, exercise care to prevent damage to the post. (Page 7-11 and 7-19)

Never throw away the Aero-7D shorting button and dust cap, or the LAU-3A/A safety pin, where it is possible for them to be picked up by a jet aircraft intake. Severe engine damage may result. (Page 7-23)

Frontispiece. A-4D Skyhawk with Aero 6A Aircraft Rocket Launcher Packages Installed.

Chapter 1
GENERAL INFORMATION

1-1 PRINCIPLES OF ROCKET PROPULSION

Rockets are propelled by the rearward expulsion of expanding gases from the nozzle of the motor. It is a common misconception that rockets are pushed forward by the action of the hot gases on the surrounding air, but rockets can function even in a vacuum.

To understand how a rocket operates, consider a closed tube into which a gas under pressure has been introduced. The pressure of the gas against all the interior surfaces is equal, and the system is in equilibrium, figure 1-1(A). If the right end of the tube is removed, figure 1-1(B), the pressure against the left end is unopposed and the tube tends to move to the left.

In a rocket motor, sufficient confinement of the gases evolved in the burning of the propellant is necessary to permit a buildup of pressure to provide the sustaining driving force. The rate of burning will decrease if the motor pressure is lost. The buildup of pressure can be accomplished by restricting the size of the opening, as in figure 1-1(C). In this case, the useful thrust is the difference between that force acting on the remainder of the left end and that acting on the right end. However, with this type of design, considerable turbulence is caused in the flow of gas through the opening, with a consequent loss of available energy. This turbulence can be decreased greatly by adopting a design similar to figure 1-1(D). In this instance, the horizontal component of the force acting on the right

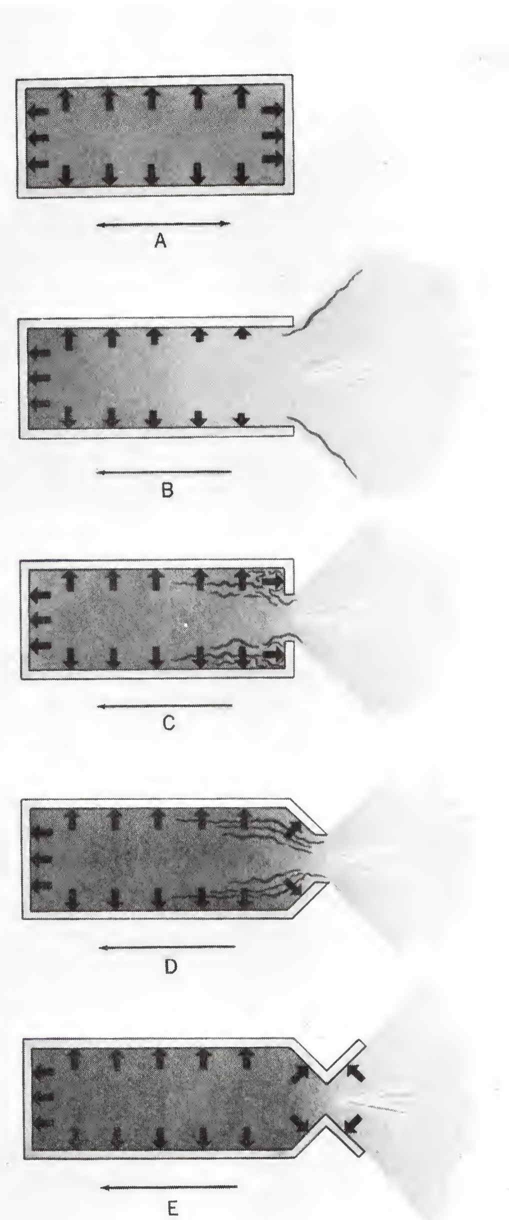


Figure 1-1. Principles of Rocket Propulsion

wall is equal in magnitude to the force acting on the right wall, figure 1-1(C).

If a divergent expansion section is added, figure 1-1(E), advantage can be taken of the force of the expanding gases acting on the wall of the expansion section. This force adds to the useful thrust.

1-2 AIRCRAFT ROCKET DEVELOPMENT

1-2.1 ROCKET HISTORY TO WORLD WAR II. Although the history of rockets covers a span of eight centuries, their use in aircraft armament began during World War II. Rockets answered the need then for a large missile which could be fired without recoil from a plane.

The first Navy development was a rocket-propelled bomb, a weapon designed to increase the bomb penetration of armor without increasing the altitude from which it was dropped. Despite the promise of armor-piercing bombs, they proved less valuable in practice than bombs which compensated for their lack of penetrative ability with a greater volume of explosive. Success with general-purpose bombs and new attack techniques made large-scale procurement of rocket-assisted bombs unjustified later in the war.

1-2.2 RETROBOMB. A subsequent Navy project was the development of the retrobomb, a missile fired backward from a plane at the same speed that the plane was traveling, so that the missile would fall straight to the target. This type of weapon was needed for use with the Magnetic Airborne Detector (MAD), a device for locating submarines.

The MAD is an instrument which indicates the presence of a submarine only when the plane is directly above the submarine. Ordinary bombing or depth charging is impracticable because the trajectory of either weapon follows the path of flight of the plane.

The usefulness of the retrobomb was shortlived because planes were forced to fly directly over submarines at altitudes between 100 and 300 feet in order to make a hit. Learning this, submarine commanders surfaced and used their antiaircraft guns effectively against the planes before the planes could get within bombing range.

1-2.3 LATER DEVELOPMENTS IN WORLD WAR II. The early discarding of the rocket-propelled, armor-piercing bomb and the retrobomb did not discourage those who realized the advantages of rockets as aircraft weapons. The speed of planes lent an initial velocity to fin-stabilized rockets that produced stability and accuracy not possible from shipborne launchers. The size of rockets promised a destructive power far beyond the aircraft machine guns.

A rocket employing a 3.5-inch solid warhead and a 3.25-inch motor was designed for launching from rails under the wings of torpedo bombers. The purpose of the solid warhead was to rupture the hull of a submarine.

A 5-inch warhead with a larger payload of high explosive and an air-arming fuze was designed for the same 3.25-inch motor. The assembly, however, was unsatisfactory in accuracy and range. A new design, employing the same 5-inch warhead plus a 5-inch motor, was developed. It was known as the high-velocity aircraft rocket (HVAR). It was put into combat use successfully in August 1944.

The need for a simple, economical rocket for practice firing resulted in the 2.25-inch subcaliber aircraft rocket (SCAR).

Meanwhile, work was in progress to develop the largest practicable

rocket which carrierbased aircraft would be capable of carrying. This project produced the TINY TIM, a rocket comprising a 500-pound semi-armor-piercing bomb, measuring 11.75 inches in diameter, and an 11.75-inch motor. The rocket was launched from a slightly modified bomb rack. TINY TIM, first used in action in March 1945, had the effect of a 12-inch projectile, capable of penetrating 4 feet of concrete.

Rocket development during World War II did not follow a normal plan. Time was not available for detailed study of the whole complex of rockets: their components, materials, launchers, and personnel factors. There were not enough of certain materials to produce the best designs.

A case in point is the 11.75-inch rocket. The 11.75-inch pipe for the motor tube was chosen because the material was not on the critical list and also because this size of pipe coincided with the outside diameter of a 500-pound bomb, which could be used as the rocket warhead. The aircraft rocket program in World War II can be said to have ended with TINY TIM.

1-2.4 POSTWAR DEVELOPMENTS. The major postwar aircraft rocket development has been the 2.75-inch folding-fin aircraft rocket (FFAR) called the MIGHTY MOUSE, and the 5-inch ZUNI. These rockets have fins that are hinged in order to maintain the nominal caliber diameter when the rocket is in the launcher.

Use of folding fins increases the number of rounds carried in a given space and the number which may be fired from a given frontal area. The 2.75-inch rocket may be fired from single launchers or from a multiple "package" launcher. For air-to-air firing, the fuze will function only on a direct hit. One of the available fuzes, Mk 176, incorporates a delay element which allows time for the warhead to penetrate the outer skin and to detonate inside an aircraft. Other types of fuzes, such as the Mk 178, are designed for instantaneo action on impact. Although originall intended for air-to-air use, the 2.75-inch FFAR also has proved to be a potent air-to-ground weapon agains a wide variety of targets. Another more recent folding-fin, general-purpose aircraft rocket is the 5.0-inch ZUNI which has greater strikin power and a larger variety of war-heads than the 2.75-inch FFAR. The motors of both rockets are relativel insensitive to temperature and are capable of operating beyond the temperature tolerances assigned many aircraft rockets.

Rocket development today is carried out principally at the Naval Ordnance Test Station at China Lake California, although other naval activities contribute to rocket desig and testing.

1-3 COMPARISON OF ROCKETS WITH GUN AMMUNITION

In this comparison, rockets posse certain definite advantages and equal definite disadvantages. They have the advantage of being relatively simple and economical. They have small recoil force, which permits their use on aircraft without heavy, complicated launching apparatus. They possess a larger missile capacity with comparatively less weight of missile and launcher combined.

One disadvantage is that some rockets must be fired over a narrow range of temperatures. Another disadvantage is their relative inaccuracy compared to guns. The mean dispersion for aircraft rocket is of the order of 10 to 20 mils; for guns it is of the order of 1 mil or le

1-4 COMPARISON OF ROCKETS WITH BOMBS

Rockets have the advantage of propulsion, which allows their use against air targets as well as surface targets, particularly certain surface targets which cannot be attacked readily with bombs. Their propulsion gives them greater power for penetration of armor. The disadvantage of rockets compared to bombs is that they carry less payload in relation to weight.

1-5 COMPARISON OF ROCKETS WITH GUIDED MISSILES

Many current guided missiles are basically rockets, since they are rocket propelled. Guided missiles are a separate classification because they have systems which continually control their flight; however, some guided missiles may be countermeasured, rockets cannot. A simple aircraft rocket is illustrated in figure 1-2.

1-6 ROCKET TERMINOLOGY

The following are terms which are not defined elsewhere in this publication. They are illustrated in the appropriate chapters.

1. AMMUNITION—all the components, and any and all explosives in any case or contrivance prepared to form a charge, complete round, or

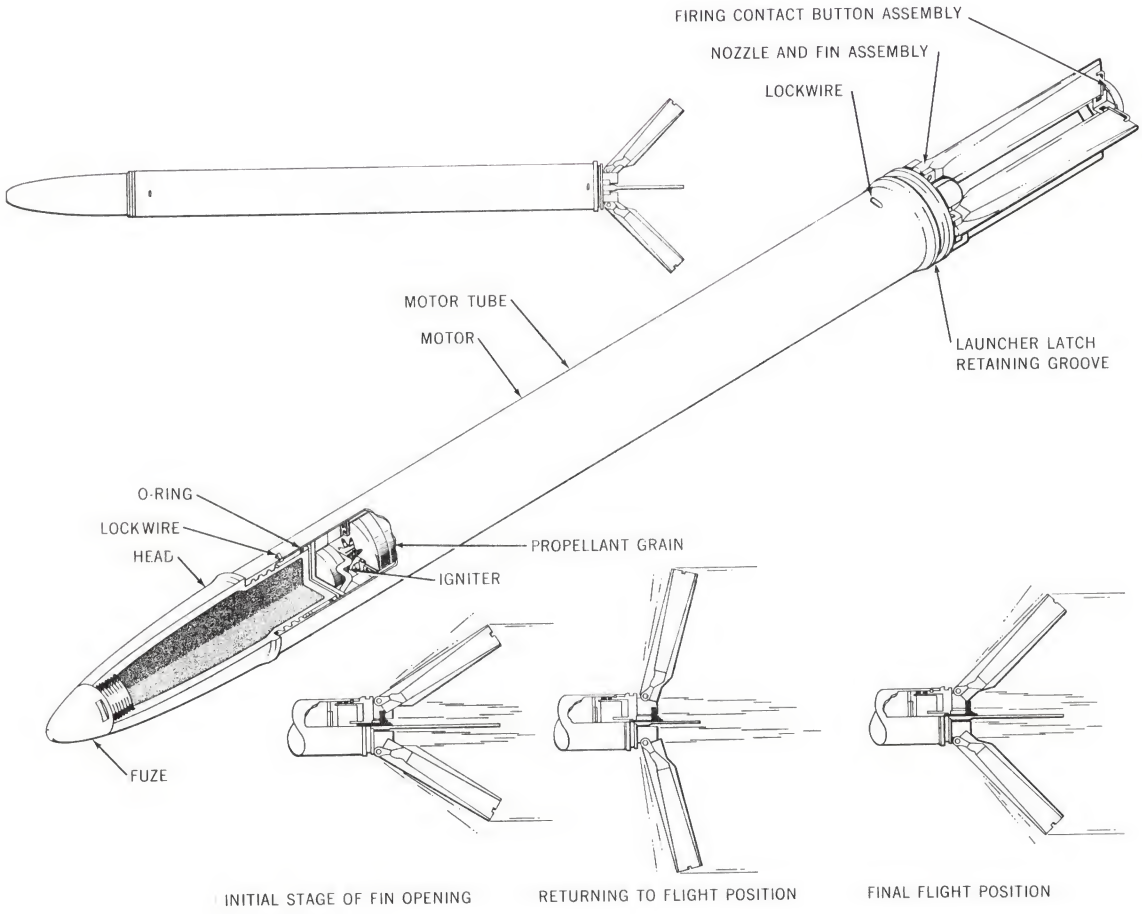


Figure 1-2. Simple Aircraft Rocket.

cartridge for cannon or small arms, or for any other weapon, torpedo warhead, mine, bomb, depth charge, demolition charge, fuze, detonator, projectile, rocket, or the like; all signaling and illuminating pyrotechnic materials; and all chemical warfare materials under the cognizance of the Bureau of Naval Weapons or used by the military services for offensive, defensive, saluting, and training purposes.

2. AMMUNITION COMPONENTS—integral units which are parts of a complete round of ammunition. Ammunition components may consist of inert parts, explosive parts, or both. Examples of ammunition components are fuzes, rocket warheads, rocket motors, rocket fins and fin assemblies, dummy nose fuzes, auxiliary boosters, igniters, and propellant grains.

3. AMMUNITION DETAILS—accessories used in packing, handling, protecting, and surveillance of ammunition; for example: containers, thread protectors, spacers, and fuze covers.

4. BOOSTER—an assembly containing an intermediate explosive, which is sensitive enough to be detonated by a small amount of initiating explosive and is powerful enough to cause detonation of a less sensitive explosive.

5. DELAY ELEMENT—an assembly containing a relatively slow-burning explosive initiated by a primer, which delays the functioning of the succeeding units of the explosive train. Black powder is commonly used in delay elements.

6. DETONATOR—an assembly in the explosive train of fuzes which contains a charge of high brisance. When fired by the primer or delay element, the detonator explodes with sufficient force to initiate a booster. Tetryl and the metal azides are common detonator charges.

7. EXPLOSIVE—a chemical compound or mixture of substances which, when subjected to suitable initiating impulses or agents such as flame, spark, heat, impact, or friction whether applied mechanically or electrically, will undergo chemical and physical transformation at speeds varying from extremely rapid to near-instantaneous. This transformation will create a more stable compound, resulting in a considerable and rapid rise in pressure caused either by the generation of a much larger volume of gas than originally present or by the evolution of large quantities of heat, without gas, and other forms of energy with consequent expansion of the surroundings or both. The transformation accomplishes work of either useful or destructive character, depending on the measures of control exercised over the reaction. A list of common rocket high explosives follows.

a. Primary explosives

Fulminate of mercury—a highly sensitive explosive used in fuze primers or detonators.

Lead azide—a highly sensitive explosive used in primers and detonators.

Tetryl—a sensitive explosive used in boosters and detonators.

b. Secondary (high) explosives

Composition B—a mixture of RDX, TNT, and wax. It is used as the main charge of some rocket warheads.

Explosive D—a relatively insensitive explosive used as a main charge chiefly in armor-piercing rocket warheads because of its ability to withstand severe shock.

HBX–a relatively insensitive explosive that is chemically stable and noncorrosive. It is in the same general class as TNT with respect to the relative safety of handling. HBX-1, which is used in some rocket warheads, is a variation developed to provide even greater stability and power.

TNT–a general purpose explosive used in cast form as a main charge in some rocket warheads not designed to pierce heavy armor. TNT is sensitive to high-order shock.

8. EXPLOSIVE TRAIN–a functional arrangement of different types of explosives in a fuze which initiates the main charge of the rocket warhead. Depending on the fuze, it may consist of a primer, delay element, detonator, and booster. Each separate component is less sensitive than the preceding charge, starting with the primer and working to the booster.

9. FINS OR FIN ASSEMBLY–a flight stabilization device, usually a number of tail planes, which tend to keep the rocket on its aimed trajectory.

10. FUZE–the initiating device which detonates a high-explosive main charge; or expels, disperses, or fires some other type of load.

11. HANGFIRE–a misfire which later fires from delayed ignition.

12. WARHEAD–that part of the rocket containing the payload; either high explosive, chemical, or special filler, and the fuze. The payload may be solid metal, with no fuze.

13. IGNITER–the initiating device which ignites the propellant grain. It usually is an assembly consisting of an electric squib, match composition, black powder, and magnesium powder.

14. MAIN CHARGE–the high-explosive filler of the rocket warhead.

15. MISFIRE–a situation in which a rocket does not fire when the firing circuit is energized.

16. MOTOR–the propulsive component of a rocket. It contains the propellant grain, igniter, motor tube, and nozzle(s).

17. PRIMER–the first element in the explosive train of a fuze. It is a sensitive explosive which usually is initiated by a firing pin and, in turn, initiates the next element, which is less sensitive, in the explosive train.

18. PROPELLANT GRAIN–the solid fuel used in a rocket motor which, upon burning, generates a volume of hot gases that exhaust from the nozzle and propel the rocket. Also called propellant or propellant powder grain.

19. RETRO-FIRED–fired in a direction opposite to the aircraft direction of flight, usually to make the rocket drop in a straight line to the target.

20. ROCKET–a missile propelled by the sustained reaction of a discharging jet of gas against the container of the gas.

21. ROUND–an assembly of all the components necessary for functioning of the rocket for the purpose intended. This includes warhead, motor, and fuze(s).

22. SUBCALIBER–a term referring to a practical round of less than the caliber of the service round. Although smaller than service rounds, subcaliber rockets have the same characteristics of trajectory.

23. THRUST–the force exerted by the rocket motor.

1-7 ABBREVIATIONS

ADF or Aux Det	auxiliary detonating fuze
ALN	ammunition lot number
AP	armor piercing
ASW	antisubmarine weapon
A/T, AT	antitank
ATAP	antitank, antipersonnel
BDF	base detonating fuze
BUWEPS INST	Bureau of Naval Weapons Instruction
CAL	caliber
CHG	charge
CTN	carton
CT-TNT	cast TNT
CWR-N	chemical warfare rocket-Navy
DNF	dummy nose fuze
DNP	dummy nose plug
DWG	drawing
EX, X	experimental
EXP	expellant or explosive
Exp "D"	Explosive "D"
FCL	fuze cavity liner
FF	folding fin
FFAR	folding-fin aircraft rocket
F	fuze
FRAG	fragmentation
FS	fin stabilized
FSL	fuze seat liner
GP	general purpose
HC	high capacity (no longer used)
HE	high explosive
HEAT	high explosive antitank (shaped charge)
HVAR	high-velocity aircraft rocket
IGN	ignition
INST	instantaneous (also "Instruction" when applicable, such as "BUWEPS INST")
LSFFAR	Low-spin folding-fin aircraft rocket
MIG	magnetic impulse generator
MTR	motor
MFR	manufacturer
Mk	mark
MM	millimeter
Mod	modification (The term "mod" is now commonly used as a noun or adjective and is no longer considered strictly an abbreviation.)
N	Navy
NAD	Naval Ammunition Depot
NAS	Naval Air Station
NAVORDINST	Naval Ordnance Instruction
NF	nose fuze
NM	naval magazine
NMC	Naval Missile Center
NOL	Naval Ordnance Laboratory
NOP	Naval Ordnance Plant
NOTS	Naval Ordnance Test Station
NPP	Naval Propellant Plant
NWS	Naval Weapons Station
OBS	obsolete
OD	ordnance data
OP	ordnance pamphlet
OS	ordnance specification
PDF	point detonating fuze
PDR	powder
PRAC	practice
PWP	white phosphorus, plasticized
PWPV	white phosphorus, plasticized, vulcanized
RADHAZ	Radiation Hazards from Electronic Devices
RKT	rocket
Rd	round
RETRO	fired in a direction opposite to the plane's direction of flight
RH	rocket head
RM	rocket motor
RTP	requirements and test procedures
SC	subcaliber
SCAR	subcaliber aircraft rocket
SER	service
VT	radio proximity; a fuze activated by its proximity to the target. It is also called variable time fuze and influence fuze (VT is a code symbol, not strictly an abbreviation.)
WP	white phosphorus

1-8 CLASSIFICATION OF ROCKETS

Rockets may be classified as either spin-stabilized or fin-stabilized. At present, all aircraft rockets are fin-stabilized. Some having folding fins; others have fixed fins.

Rockets may be classified further as to their purpose; service, practice, or dummy. Service rockets have live-loaded motors and warheads which carry a payload of high explosive, a chemical, or a special device. Service warheads are used in combat. Practice rockets have live-loaded motors and either solid heads or head with an inert load, usually of plaster. They are used for target practice.

Dummy, or dummy-drill, rockets have an inert-loaded motor and a practice head. They are used for training in handling, and for testing launchers.

Subcaliber rockets have live-loaded motors and practice heads. They are made smaller than the service rockets which they simulate for economy in practice firing. Practice and sub-caliber rockets have approximately the same velocity and trajectory as the service rockets which they simulate.

1-9 ROCKET WARHEADS

Several types of warheads have been developed to meet different tactical requirements. Specific heads are treated by mark and mod in chapter 2. Figure 1-3 illustrates the general types. Their nomenclature and description follow.

1-9.1 ARMOR-PIERCING (AP). This type is designed to penetrate armor plate or fortifications before it is exploded. Usually made of heat-treated steel, an armor-piercing warhead has thick walls and, consequently, a smaller explosive charge than other warheads.

The explosive used is one which will withstand the shock of impact without detonating. Explosive D is the charge normally employed. Since the nose section of an armor-piercing warhead must be of maximum strength, the fuze is located in the base.

1-9.2 GENERAL PURPOSE (GP). This type is a compromise between the armor-piercing and the high-explosive designs. The general-purpose warhead has a nose section and walls not as strong as those of an armor-piercing warhead, yet stronger than those of a

Figure 1-3. Types of Rocket Warheads.

high-explosive warhead. The explosive charge is more than that in the armor-piercing warhead, but less than that in the high-explosive warhead.

The general-purpose warhead is for use against a variety of targets. Its maximum penetration may be obtained by using a solid nose plug and a delayed-action base fuze. Its maximum blast effect may be obtained by using a instantaneous-action nose fuze.

1-9.3 HIGH-EXPLOSIVE (HE). This warhead is designed to damage a target by the blast of its explosive charge or by the fragments from its shell. The warhead has a relatively high percentage of explosive by weight. Because of the thinness of its walls, it will penetrate only light armor.

It is fuzed in the nose, since it is ordinarily intended for instantaneous action. However, it may be assembled with a delayed-action base fuze to allow some penetration of the target.

An auxiliary booster, figure 1-4, may be installed in an HE warhead to

Figure 1-4. Typical Auxiliary Booster.

ensure thorough detonation of the relatively large explosive filler. An auxiliary booster supplements the detonating capacity of the booster in the fuze. Granulated TNT normally is the explosive used in the auxiliary booster. Auxiliary boosters are shipped installed in the warhead.

1-9.4 HIGH-EXPLOSIVE ANTITANK (HEAT). This type was developed for use against tanks, but is equally effective against other armored or fortified targets. This warhead empl the shaped-charge principle of explosives to produce a jet of high-velocity high-temperature particles which wil force the warhead through an extraordinary thickness of armor.

The explosive jet will penetrate heavy armor metal or concrete, but will not produce an explosive blast behind the armor. The jet will materially increase the temperature behind the armor and, in the case of a small enclosure such as the inside of a tank, its searing heat normally will kill the occupants.

The explosive charge in this type o warhead is detonated at its after end to produce the jet from the cone the forward end. Detonation by the booster in the after end usually is accomplished through transmittal of the explosive impulse by a length of detonating cord. It connects the booster charge to the initiating charg which is adjacent to the nose fuze. The combination of an instantaneous-acting nose fuze and rapid-burning detonating cord permits detonation of the explosive load in time for the shaped-charge to produce its explosi jet before being disintegrated by impact on the target.

1-9.5 PRACTICE (PRAC). Practice heads are of two types, subcaliber heads and inert-loaded service heads Most subcaliber heads are a hollow metal slug, although the hollow space

may be filled with an inert material to bring the weight within required limits. One type of subcaliber head is solid metal. The inert-loaded service head is a service head in which the weight and placement of an inert filler give the head the same ballistic characteristics as those of the explosive-loaded service head, called warhead.

1-9.6 SMOKE (SMOKE). This warhead is designed to produce a volume of heavy smoke for target identification or screening purposes. It employs a tube of explosive, usually tetryl, which bursts the relatively thin walls of the warhead, dispersing the smoke. This burster tube is activated by a nose fuze. This warhead is designated SMOKE warhead and is followed by the abbreviation for the smoke-producing agent which it contains; for example, WP for white phosphorus or PWP for plasticized white phosphorus.

1-9.7 VT. This warhead was developed to receive a VT fuze. VT fuzes generally are larger than mechanical fuzes, requiring a larger space in the warhead. Essentially, a VT warhead is a high-explosive warhead with a larger fuze cavity.

1-9.8 WARHEAD DETAILS AND COMPONENTS. Rocket warheads are shipped with base fuzes installed; nose fuzes usually are shipped separately. Usually shipping plugs protect the threads for the fuze and for the motor. When auxiliary boosters are part of the rocket assembly, they are shipped installed in the warhead.

Larger rocket warheads have two spanner holes near the base, located 180 degrees apart, to facilitate assembly of the warhead and motor. An adapter ring in some nose assemblies permits use of more than one thread size for fuze installation.

A metal or plastic cup may be secured in the nose or base portion of the explosive filler. This cup, which is a fuze cavity liner or fuze seat liner, allows installation or replacement of fuzes without contacting the surface of the explosive filler. If a cavity liner or seat liner is used as a "former," or a former plug is used, it eliminates the need for machining the cavity in the explosive filler during loading of the warhead.

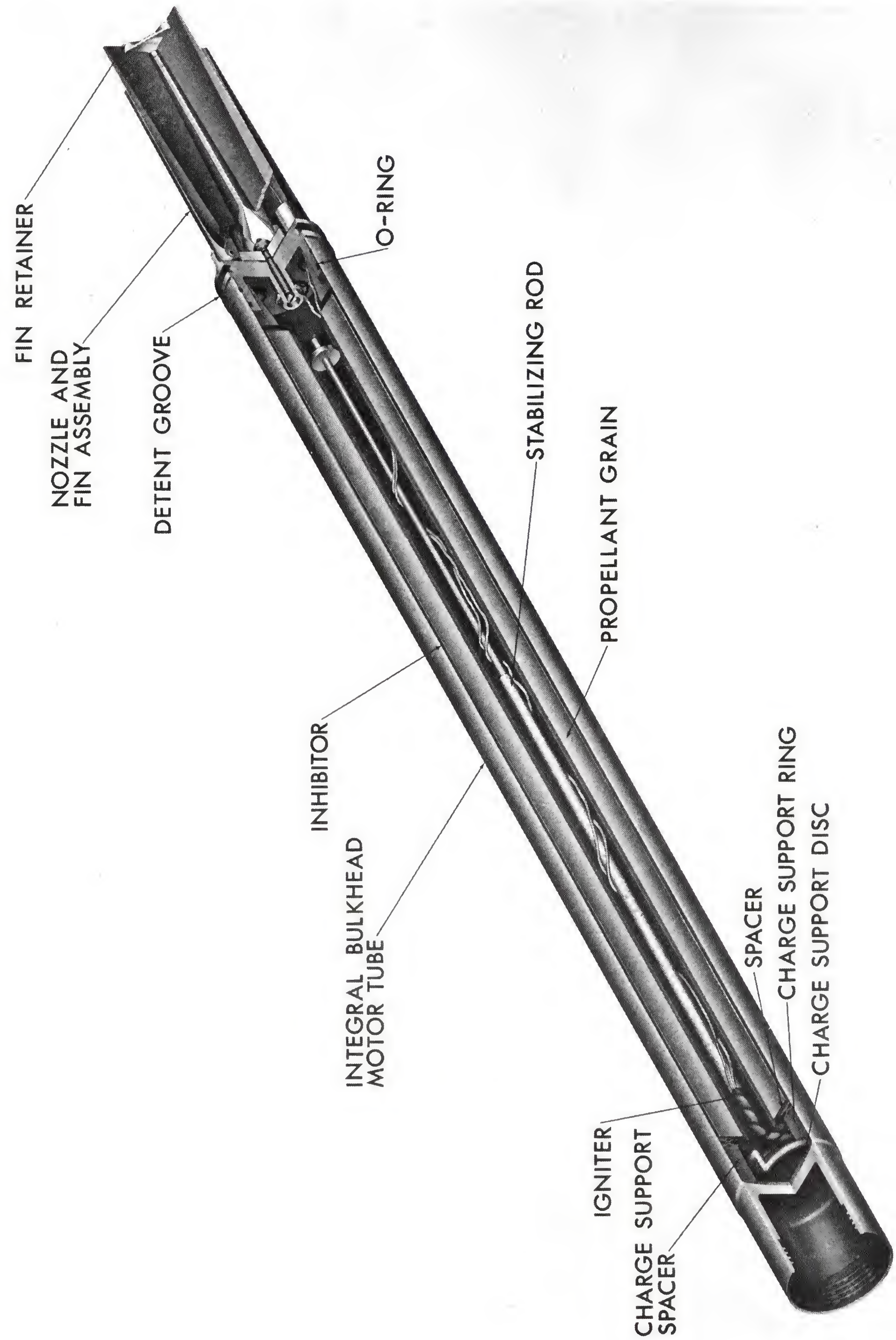
1-10 ROCKET MOTORS

The principal parts of rocket motors are described and illustrated, figure 1-5, in this section. Specific information on particular marks and mods is given in chapter 3.

1-10.1 MOTOR TUBE. The tube usually is a steel or aluminum cylinder. One end is secured to the rocket head. The other end receives the nozzle assembly. The tube holds the motor components in place and provides a combustion chamber for the propellant. The design shown in figure 1-5 uses an integral bulkhead for the forward closure.

1-10.2 PROPELLANT. All rockets described in this publication use a solid propellant. This propellant is similar in composition and function to gun ammunition propellant powder, but usually is in the form of a single long grain.

Rocket motors need a propellant that burns evenly and continuously. Gas pressure must be sufficient to propel the round and yet not so high that it bursts the relatively thin metal walls of the motor tube. To utilize the advantages of smokeless powder and, at the same time, meet these other requirements, a double-base smokeless powder, ballistite,


FIN RETAINER
NOZZLE AND FIN ASSEMBLY
DETENT GROOVE
O-RING
STABILIZING ROD
PROPELLANT GRAIN
INHIBITOR
INTEGRAL BULKHEAD MOTOR TUBE
SPACER
CHARGE SUPPORT RING
CHARGE SUPPORT DISC
IGNITER
CHARGE SUPPORT SPACER

is employed. Ballistite has the following approximate proportions:

	Percent
Nitrocellulose (gun cotton)	52
Nitroglycerine	43
Plasticizer (diethylphthalate)	3
Stabilizer (diphenylamine)	0.7
Flash depressant (potassium nitrate)	1.3
Opacifier (nigrosine dye)	0.1 added after ballistite is prepared

Propellant grains, figure 1-6, are shaped to permit the proper flow of gases to the nozzles and also to control the rate of burning. Grains are shaped to provide neutral progressive, or regressive burning.

Neutral burning grains provide a relatively even thrust throughout the rocket flight that is particularly desired for air-to-air rockets. Such grains have a burning area that remains relatively constant until the propellant is almost consumed. Star-perforated grains, which are inhibited on the ends and exterior, can provide such even burning. Star-perforated grains may be cast for large rockets. Hollow cylindrical grains which are consumed from the exterior as well as the interior also are capable of providing neutral burning.

Progressive burning grains provide a gradually increasing thrust that is desired for ground-to-air rockets. Such grains have a burning area that increases in size as the propellant is consumed. Cruciform grains, for example, if inhibited on the ends, will burn progressively.

Regressive burning provides a high initial thrust that gradually diminishes. It is desired in certain air-to-ground rockets. It requires grains that present a large burning area at first, which decreases as the rocket continues in flight. Solid cylindrical grains can provide such burning characteristics. Multiple grains, which consist of a number of solid cruciform grains, are used in

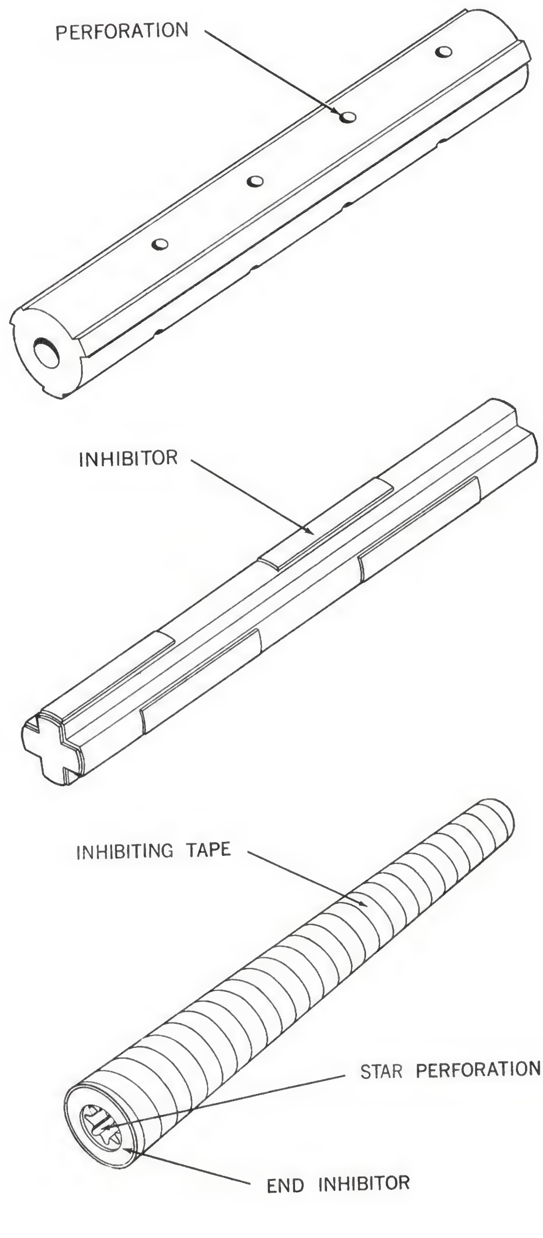


Figure 1-6. Typical Propellant Grains; Cylindrical Grain With Radial Perforations (top), Cruciform Grain With Inhibitor Strips (center), and Star-Perforated-Internal-Burning Grain (bottom).

11.75-inch rocket motors. Although these motors are obsolete for service use, they are useful for sled tests and for other problems where a large initial thrust is needed.

1-10.3 INHIBITORS. These are lengths of fire-resistant material used to prevent combustion of the surface to which they are cemented. They may consist of short rectangular plastic strips such as those used on cruciform grains, or they may be long tapes such as those spirally wrapped around certain cylindrical grains.

1-10.4 IGNITER. The igniter heats the propellant grain to ignition temperature. It is a thin, disc-shaped metal container which fits against the forward end of the propellant grain. The igniter contains black powder, magnesium, or both, and one or two electric squibs. The squib consists of a resistance wire filament (the bridge) encased in match composition. Lead wires extend from the squib through the wall of the igniter. The lead wires pass along the length of the propellant grain and through a nozzle to the wire connectors. In the ZUNI motor, lead wires are brought through the forward bulkhead.

Igniters are designed to respond in a minimum time with a squib current of 1.0 ampere or more, although as small a current as 0.2 ampere will set off the match composition and black powder after a short delay. The nominal resistance of the squib is 1.0 ohm; therefore, ignoring any line resistance, application of 0.2 volt is sufficient to set off the charge. Application of 0.75 volt gives satisfactory performance. In practice, the line and contact resistances of the igniter require higher voltages.

> NOTE: HVAR and ZUNI igniters have two squibs in parallel, thus requiring more power to fire.

To ensure that the circuit to the igniter in a rocket motor has the proper resistance, for safety and for ignition, tests are made at ammunition depots. Testing of this circuit is not permitted on board ship because of the danger of accidental ignition of the motor.

1-10.5 NOZZLES. Nozzles direct the gas jet and utilize the expansion of the gas in an exit cone to increase total thrust, about 30 percent more than a simple opening. They also restrict the escape of gas from the reaction chamber, thus maintaining the pressure within the motor tube at a value suitable for the continued burning of the propellant.

Nozzles are metal parts formed as illustrated (see figure 1-5). Some single nozzles are threaded directly to the motor tube. Other nozzles are pressed, brazed, or staked to a nozzle plate which is secured to the motor tube.

Some nozzle assemblies employ a central, "extra" nozzle as a safety device. In this particular arrangement, a thin copper plate is blown out of the central nozzle if the pressure i[n] the motor tube reaches a predetermin[ed] level. The copper plate at the rear is insulated from the heat of the burning propellant by asbestos. The plate wil[l] not blow out in normal firing and burn[n]ing of the motor. If extreme pressur[e] does blow out the plate, the central nozzle utilizes the escaping gas pressure to increase the thrust of the motor.

1-10.6 SPACER. The spacer is a metal ring designed to allow the void between the motor tube inner wall and the propellant grain inhibito[r] to become pressurized during propellant burning. This prevents grain cracking since the areas inside and outside the grain are at the same pressure.

1-10.7 CHARGE SUPPORTS. The charge supports are made of vibra-damp, a fiber glass material, and are used to locate, support, or cushion the propellant grain and igniter. The primary purpose is to allow expansion and contraction of the propellant grain during temperature cycling while still preventing free movement during routine handling.

1-10.8 DETENT GROOVE. The detent goove is used in conjunction with a rocket launcher detent to prevent movement of the assembled round during aircraft catapult takeoffs and arrested landings. It is also used as one of the connection points for the firing circuit between the launcher and motor in some rocket systems.

1-10.9 O-RING. The O-ring is a rubber gasket used to prevent propellant gas from escaping within the motor tube.

1-10.10 FINS. Fins are hinged in such a way that they are folded behind the nozzle closure before launching. They are forced into a projecting position after launching. This arrangement permits greater economy of space needed for launchings; consequently, more rockets can be launched from a given space, or the reduced space requirement can be applied to improving the design of the aircraft.

1-10.11 FIN RETAINER. The fin retainer is a plastic device used to keep the fins from opening during handling. In some cases (see figure 1-5), it serves the additional function of supporting one of the electrical connection points between the launcher and the motor firing circuit.

1-10.12 STABILIZING ROD. The stabilizing rod is used to prevent unstable burning of the propellant grain.

1-11 ROCKET FUZES

1-11.1 CLASSIFICATION. Rocket fuzes are classified according to their location in the rocket warhead or according to type of action of the fuze. Fuzes classified according to location are either nose fuzes or base fuzes. The following are fuzes classified as to type of action:

1. Impact-firing fuzes are those that function when the rocket strikes a target which offers sufficient resistance. These also may be called point-detonating fuzes (PDF) or base-detonating fuzes (BDF). These fuzes may be designed to fire either instantaneously or after a short delay that affords the rocket time to penetrate the target before the warhead explodes.

2. VT (proximity-firing) fuzes are those which incorporate a radio transmitter and receiver and, after being launched, send out signals and receive the same signals reflected by the target. If the strength of the reflected signal is sufficient, the receiver triggers an electronic firing switch which starts the detonation of the firing train. Because of their special nature, only the exterior characteristics and assembly instructions for current VT fuzes are given in this publication.

1-11.2 DISASSEMBLY. Breakdown of aircraft rocket fuzes is not permitted except at authorized activities.

1-11.3 USE OF LUBRICANTS AND PRESERVATIVES. No lubricants or preservatives of any kind shall be used on any fuzes.

1-11.4 MOISTURE DAMAGE. Sensitive explosive material loses its effectiveness if it absorbs moisture. Rocket fuzes require gaskets or other sealing methods to make them moistureproof. For shipping, fuzes are

packaged in hermetically sealed, tear-strip containers. Special care should be taken to prevent damage from moisture to fuzes which have been installed in rockets.

1-12 FORCES USED IN ARMING ROCKET FUZES

The forces which are used to arm rocket fuzes depend upon the characteristics of the rocket for which the fuze is designed.

1-12.1 SETBACK. Setback is the term applied when fuze parts react to acceleration of the rocket. It causes movable parts to move aft when the fuze as a whole moves forward. Slow accelerations, compared to gun ammunition, are characteristic of rockets. The acceleration depends greatly upon the initial temperature of the propellant; it is quite small at low temperatures in some cases. By making the parts operated by setback relatively massive and the retaining mechanisms relatively weak, small setback forces can be utilized effectively.

1-12.2 ACCELERATION. This term applies to fuzes which use a gear timing device in conjunction with the setback principle described. A simple setback-armed fuze is armed by initial acceleration; acceleration-armed fuzes are armed by prolonged acceleration, the length of which is determined by the integral timing mechanism of the fuze.

1-12.3 AIR OR WATER TRAVEL. The force exerted by the air or water stream passing the rocket may be used to arm nose fuzes by turning propeller vanes.

1-12.4 GAS PRESSURE FROM BURNING PROPELLANT. During the burning of the rocket motor propellant, pressure of the gases is exerted on the base of the rocket warhead and base fuze. This pressure is fairly constant during burning and is of th magnitude of several thousand psi. Entrance of the gas can be controll to delay the arming of the fuze.

1-12.5 CREEP. Creep is a continu ous inertial force caused by decele tion which, in turn, is caused by su face drag on the rocket after the motor has burned out. Internal fuz parts tend to move toward the nose of the round. These forces may be controlled by anticreep springs, which prevent fuze initiation until t fuze strikes a target with sufficien impact to overcome the resistance of these springs.

1-12.6 FRICTION. Frictional forc which are a consequence of setbac and creep are not high in rockets. Friction is not utilized to any exte at present in rocket fuze operation

1-12.7 IMPACT INERTIA. Inertia existing at the moment of impact i used in some rocket fuzes to bring bout a phase of arming. Fuzes usi this force are identified as deceleration-discriminating.

1-13 EXPLOSIVES USED IN ROCKET FUZES

The explosive train of a rocket f may consist of combinations of the following: primer, delay element, detonator, detonator lead-outs, booster lead-ins, booster, and aux iliary booster.

1-13.1 PRIMER. There are two classes of primers used which are initiated by firing pins—the stab-t and the percussion-type. The stal type, figure 1-7, is initiated by th penetration of a sharp-pointed firi pin through the metal case into th primer mixture. Stab-type prime generally are used when maximun

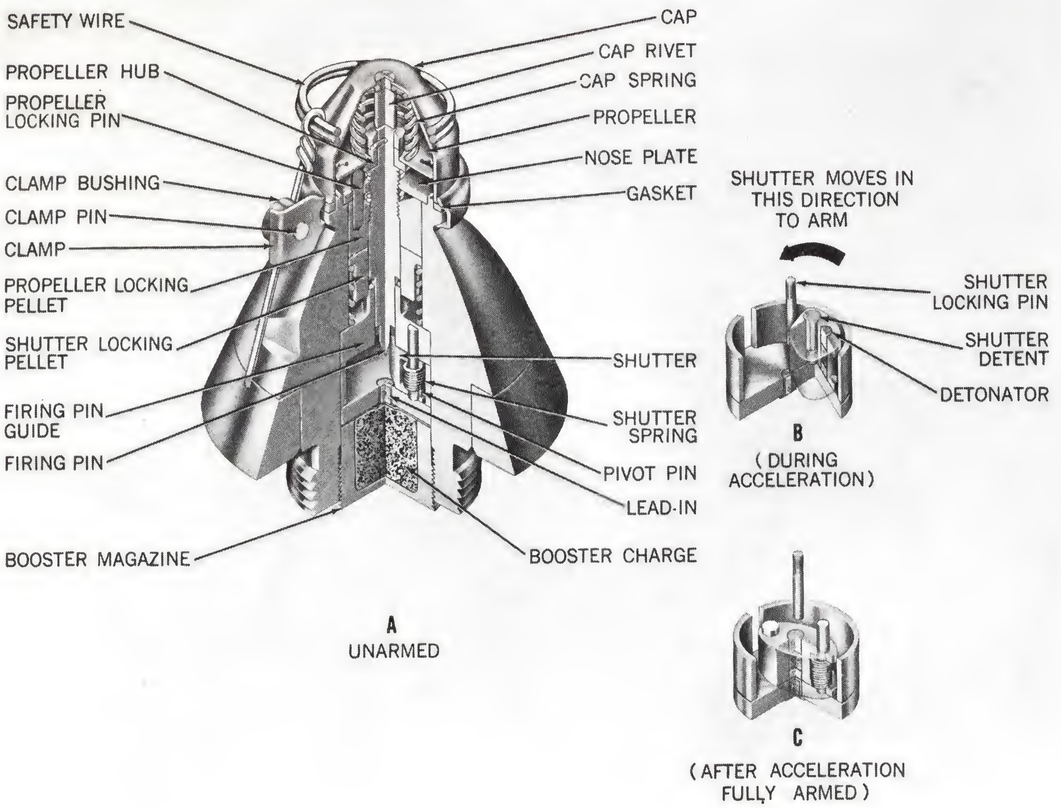


Figure 1-7. Typical Nose Fuze (Setback-and-Air-Travel-Arming, Impact-Firing), Sectional View.

sensitivity is desired. The percussion-type, illustrated as part of a typical base fuze, figure 1-11, is initiated by crushing the primer against an anvil with a round-pointed firing pin.

Primer mixtures are intended to produce flame, hot gases, and particles, as a result of being struck or otherwise mechanically disturbed. They generally are composed of a sensitive initiating substance, such as lead azide or mercury fulminate; an oxidizing agent, such as potassium chlorate; and a reducible substance, such as antimony sulfide. They also may contain a friction-creating material, such as fine carborundum crystals.

1-13.2 DELAY ELEMENT. The delay is accomplished by means of a pyrotechnic delay column. The delay time is controlled by the composition of the pyrotechnic material and the length of the burning column.

1-13.3 DETONATOR. The detonator is initiated by the firing pin, primer, or delay element. It is composed of a pure initiating explosive, usually lead azide, followed by a small amount of tetryl. These materials may be sealed separately in small containers or together in one container. Relay detonators may be employed to pick up the flash from another detonator or a primer at a relatively distant location. (For a simple detonator see figure 1-7; a detonator with lead-outs is shown as part of the deceleration-discriminating base fuze of figure 1-12.)

1-13.4 LEAD-OUT AND LEAD-IN. The lead-out and lead-in usually are small pellets of tetryl, which reinforce the explosion of the detonator and transmit it to the booster. The base fuze illustrated in figure 1-12 has both lead-outs and lead-ins. The lead-out is initiated by the detonator and, in turn, fires the lead-in which initiates the booster.

1-13.5 BOOSTER. The booster, illustrated in figure 1-12, is a comparatively large tetryl pellet, loaded in a magazine as part of the fuze. It usually is initiated by a lead-in and, as the final element of the explosive components of a fuze, initiates the explosive of the warhead.

1-14 SAFETY FEATURES IN FUZES

In general, the safety requirements for rocket fuzes are similar to those for gun ammunition and bomb fuzes. They contain devices to prevent detonation from normal transporting, handling, assembling, loading, and launching of the rocket.

Design requirements usually call for a detonator-safe fuze. This means that the explosive train must be interrupted so that, if the detonator is prematurely initiated while the fuze is unarmed, the booster of the fuze and, hence, the explosive filler of the warhead will not be detonated. In some fuzes, this is accomplished by out-of-line locations for the detonator and the booster when the fuze is in an unarmed condition. In other fuzes, the flash from the primer is blocked. The arming of a fuze is mainly the aligning of the detonator and booster, or the opening of the flash path.

1-15 FUZE OPERATION

The marks and mods of rocket fuzes usually involve only minor changes in the design of a relatively few basic types. This section describes the operation and general characteristics of these prototypes. In chapte[r] 4, specific fuzes, mark and mod, are treated. The specific mark and mod will be described in the following paragraphs by reference to its prototype.

1-15.1 TYPICAL SETBACK-AND-AIR-TRAVEL-ARMING, IMPACT-FIRING NOZE FUZE. Because of its basically rugged construction, th[is] type of fuze (see figure 1-7) will penetrate moderately thick steel pla[te] or reinforced concrete without allow[ing] breakup of the rocket warhead in a manner that would impair the warhead effectiveness. A cap which fits over the nose of the fuze protects the propeller and keeps it free of ic[e].

The internal mechanism of this type of fuze is housed in a heavy, conical steel body. The body cavity is closed at the forward end by a nose plate which is crimped in plac[e]. There are two holes in the nose plat[e]. The firing pin is threaded into the central hole; the propeller locking pin extends through the other hole. A propeller and a hub are riveted to the forward end of the firing pin.

The firing pin extends rearward through the propeller locking pellet, pellet, firing pin guide, and into the shutter cavity. It helps to hold the spring-actuated shutter, containing the detonator, in the unarmed positi[on]. The propeller locking pellet and shu[tter] locking pellet, which contain the pr[o]peller locking pin and shutter locki[ng] pin respectively, are both held forw[ard] by the setback spring. The rear of the setback spring rests against th[e] firing pin guide. The sleeve, shutte[r] assembly, and lead-in disc are sec[ured] by the booster magazine.

The fuze is waterproofed and is protected at the forward end agains[t]

damage in handling by the cap assembly. The cap assembly consists of a cap, cap spring, and cap rivet. The open end of the cap is pressed against a fiber gasket (the outer gasket) and is held in place by a clamp. The cap spring pushes the cap assembly and clamp away from the propeller during arming. The cap rivet holds the spring in place and prevents the firing pin from turning to an armed position while the cap is clamped to the body.

The clamp is made of two half-circular steel strips hinged together. Each edge of each strip is formed to a channel shape that will pull the body and cap together as the clamp is closed and tightened. Each clamp arm, 180 degrees away from the clamp hinge, is flanged away from the center of its half-circle. These flanges are drilled and held together by a clamp pin, a clamp bushing, and a safety wire.

The clamp pin is shaped somewhat like a flathead rivet, the head being too large to go through the drilled holes of the clamp flange. Its shank has two holes drilled to match two holes in the bushing. After the clamp pin is placed in the clamp flange holes, the bushing is placed over the shank of the pin, and the safety wire is inserted in the outer hole of the bushing and pin. After loading the complete round onto a plane, the arming wire on the plane is placed in the innermost hole of the bushing, and the safety wire is removed.

When the rocket is fired, the arming wire is pulled from the clamp pin and bushing, allowing the clamp to open. The compressed cap spring then propels the cap and clamp away from the fuze.

The force of setback causes the two locking pellets to move aft, thereby unlocking the propeller hub and interposing a shutter lock by means of the shutter locking pin. The firing pin is withdrawn from the shutter cavity after eight revolutions of the propeller. The shutter locking pin continues to hold the shutter in an unarmed position.

At the end of the acceleration (burning), the setback spring (under the influence of creep) forces the pellets forward, withdrawing the shutter locking pin from the shutter cavity. This permits the shutter spring to pivot the shutter against the shutter stop pin. The shutter is secured in this firing position by the shutter detent. The firing pin, detonator, and booster lead-in now are in alignment and the fuze is fully armed. There is an arming delay of about 0.1 second after acceleration has ceased.

Upon impact with a target offering sufficient resistance, the firing pin is driven rearward, shearing the nose plate threads and piercing the detonator. The detonator initiates the booster lead-in, and the lead-in initiates the booster.

This fuze is detonator safe. When the fuze is unarmed, the detonator is held out of line with the booster lead-in by the firing pin and shutter locking pin.

The firing pin cannot be withdrawn from the shutter cavity until the protective nose cap is removed and setback has occurred. The shutter cannot move the detonator in line with the lead-in until the propeller has made eight revolutions and has withdrawn the firing pin, setback has ceased, and the setback spring has moved the shutter locking pin out of the shutter cavity. If the nose cap should accidentally become removed from the fuze, it would be necessary for a prolonged setback to take place at the same time that a turning force

was applied to the propeller in order to arm the fuze.

The following precautions should be observed in handling this type of fuze.

1. If the fuze is armed, whether assembled in the rocket warhead or not, no attempt should be made to unarm it. If the fuze is armed, turning the propeller counterclockwise, as viewed from the nose, will cause the firing pin to pierce the detonator and set off the explosive train.

2. The fuze is safe as long as the cap assembly is held in place by the safety wire or the arming wire. If the cap assembly comes off by accident, the fuze is still safe as long as the propeller is engaged by the propeller locking pin. This can be determined by visual inspection. The fuze shall be considered armed if the propeller is out of engagement with the propeller locking pin and is free to rotate.

3. Armed fuzes must NOT be fired from rocket launchers.

4. If the fuze in an assembled round is armed inadvertently, the propeller should be taped carefully to prevent further rotation. The fuze then should be unscrewed carefully from the rocket, taking care not to drop the fuzed round or the fuze on its nose, or strike the fuze in any way. This work should be done by explosive ordnance disposal personnel, if possible. If none is available, disposal should be as instructed by the officer in charge.

1-15.2 TYPICAL ACCELERATION-ARMING, IMPACT-FIRING NOSE FUZE. All current fuzes for the 2.75-inch rockets have the same type of arming mechanism: an unbalanced rotor which drives a gear-train timing system as it moves to the armed position. These fuzes do not employ arming wires or propellers; one of the design requirements was that they be free of external arming devices. Thus they can be made completely moistureproof.

There are no base fuzes in 2.75-inch aircraft rockets.

1-15.2.1 Description. This fuze is armed by a required amount of acceleration over an established length of time. If acceleration of the rocket is too low or extends over too short a period of time, the arming mechanism will return to the unarmed condition. If the fuze is accidentally dropped on its base from a considerable height, it may become inoperable or the arming may be started. However, the arming cycle will not be completed because the inertial force of dropping is not sustained. Therefore, the fuze is not made hazardous, but may be unserviceable, if the arming is started in this way.

This type of fuze is housed in a one-piece body, figure 1-8. The internal components are inserted through the aft end, which is closed by the booster cup. The plastic hammer and stab-type firing pin are secured in the nose by an antisetback shear washer and closing nut. The armed assembly and rotor arming mechanism, figures 1-9 and 1-10, consist of the rotor housing base, the unbalanced rotor, the gear segment and escapement, and the setback weight. The setback weight floats on two springs surrounding two guide pins. The rotor is essentially disc-shaped. One segment is machined to a thin web so that, when mounted, the rotor is unbalanced. The heavy side of the rotor is diametrically drilled from two directions to receive the primer at the forward end and the detonator and delay element, if present, at the aft end. The rotor lock roller is fixed to one face of the rotor. On the

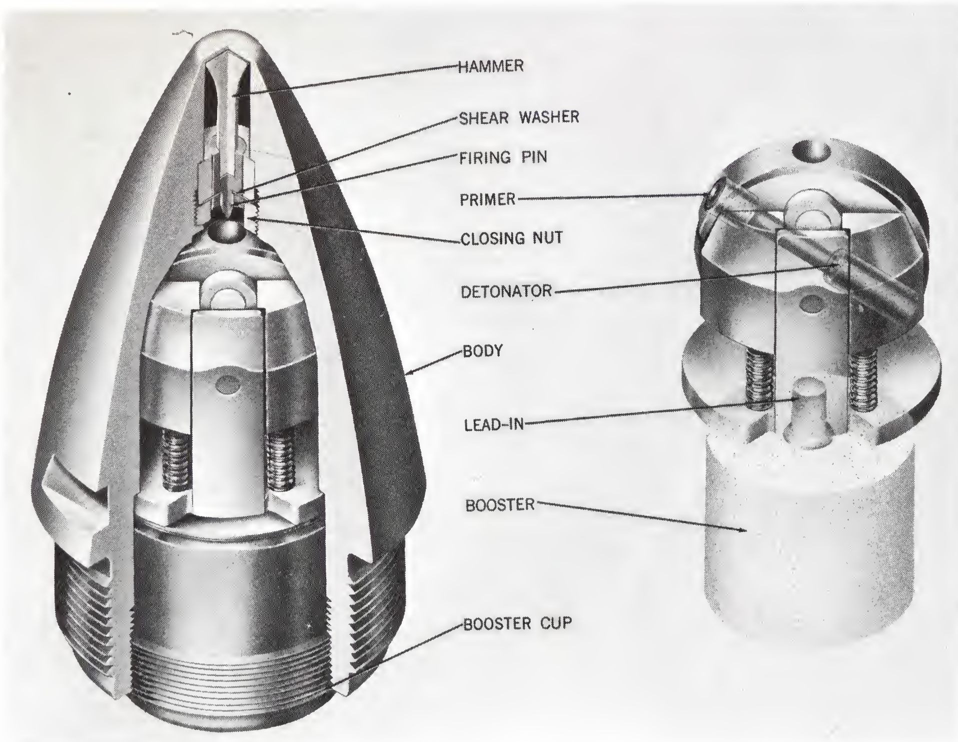


Figure 1-8. Typical Acceleration-Arming, Point-Detonating Nose Fuze in Unarmed Position: Cutaway View (left); Explosive Components in Unarmed Position, Phantom View (right).

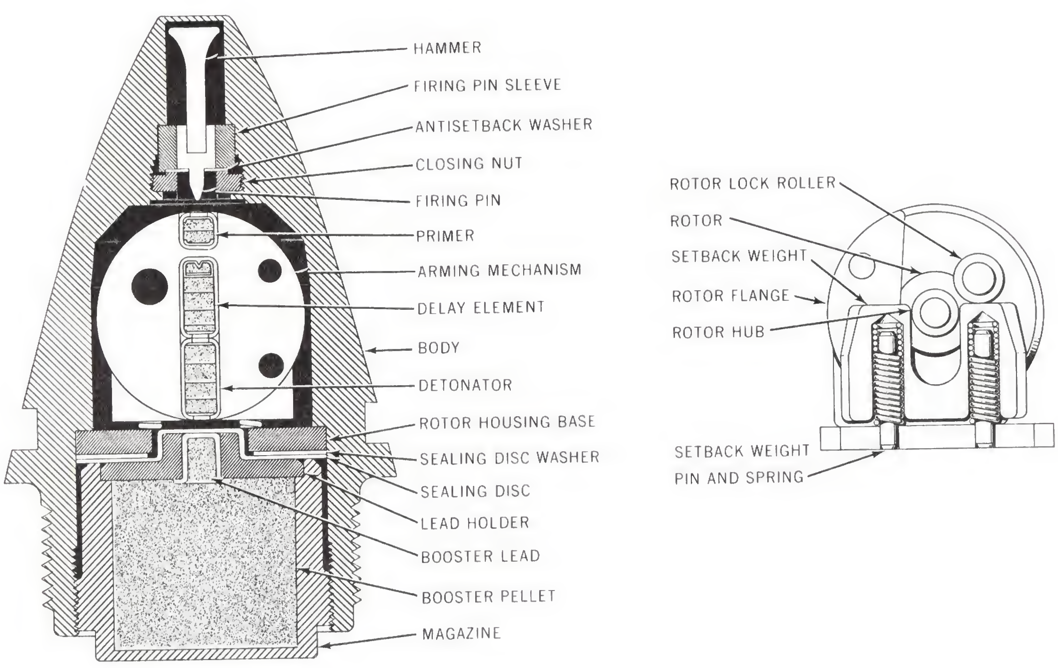


Figure 1-9. Armed Fuze Assembly and Rotor Arming Mechanism Removed From Fuze.

opposite side of the rotor is attached an annular gear by which the rotor drives the gear train of the timing mechanism. This gear train is supported between the inner and outer plates.

The axial movement of the setback weight is guided by the two guide pins and springs. A channel is milled on the outboard side of the weight to provide clearance for the side support. The U-shaped setback weight holds the lock roller to prevent the unbalanced rotor from turning to the armed position. When setback (acceleration of the rocket) causes the setback weight to move aft against its spring, the lock roller is released.

Setback causes the unbalanced rotor to turn to the armed position and the rotor primer is aligned between the firing pin and the booster lead-in. The angular travel of the rotor is limited by the rotor stop, which is fastened to the inner plate.

A small spring-loaded detent is mounted between the inner and outer plates. A detent well, located in the rotor face, receives the detent when the fuze is armed. A detent-lock spring, mounted on the outer plate, provides a positive lock to hold the detent in the detent well.

A sealing disc and a sealing washer between the lead-in disc and the rotor housing base prevent the entry of moisture.

1-15.2.2 Operation. When the rocket is fired, setback forces cause the setback weight to move aft. This releases the unbalanced rotor which, in rotating, drives the timing

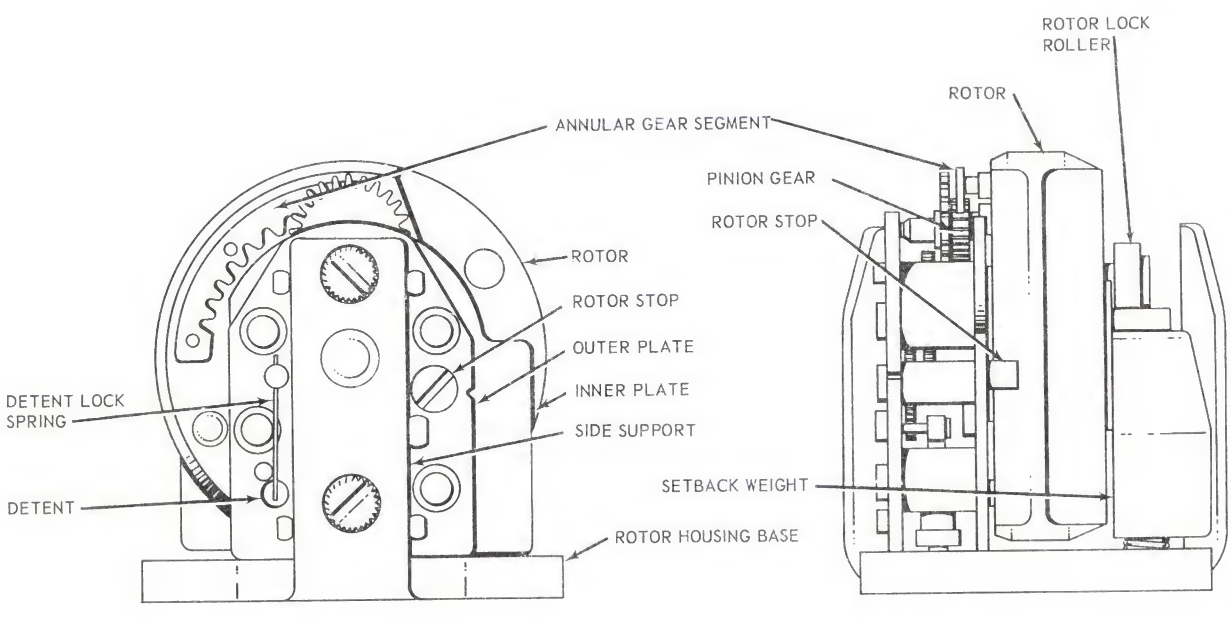


Figure 1-10. Rotor Arming Mechanism Removed From Fuze.

mechanism. After turning 48 degrees, the rotor reaches its armed position where it is locked in place by the detent. The explosive train is now in line with the firing pin and the fuze is armed. The time required for the rotor to reach the armed position is determined by the geared escapement which is driven by the annular gear on the rotor. The escapement frequency is governed by the force applied to the gear train by the rotor, plus the position of the weight on the pulley lever or the weight of the fixed escapement, whichever is applicable. Since the force exerted by the rotor is the setback force received from acceleration of the rocket, the arming time of the fuze is a function only of the acceleration of the round, and the arming time can be varied due to the position of the nut or weight, or by changing the weight.

The arming mechanism provides for an arming distance of approximately 400 to 1350 feet. The exact arming distance for a particular fuze is determined by the manufacturing tolerance in the arming mechanism and the rocket motor thrust. The rotor will arm in less than 1.50 seconds when subjected to acceleration at approximately 20 g; when subjected to acceleration at approximately 40 g, it will arm within a period between 0.68 to 0.84 second. When the arming mechanism has been subjected to acceleration between approximately 13.5 and 20 g, it will begin to arm. The setback weight will become partially retracted and the rotor will partially turn. When acceleration ceases, the spring will move the weight forward. The weight will bear against the rotor lock roller and drive the rotor back to the unarmed condition. When subjected to acceleration less than 13.5 g, the setback weight will not move and the rotor will remain in the unarmed position.

When the fuze strikes the target, the thin diaphragm in front of the hammer is crushed, and the hammer drives the firing pin through the antisetback washer into the primer. This initiates the primer which, in turn, initiates the detonator, the lead-in, and the booster. Some fuzes of this type have a delay element between the primer and the detonator. This delay element is a slower burning explosive that is activated by the primer and burns for an established length of time before initiating the detonator.

1-15.2.3 Safety Precautions. Acceleration-arming, point-detonating nose fuzes which are damaged to any extent should be considered hazardous items and disposed of accordingly.

Fuzes found corroded should be returned to an ammunition depot in the rocket warhead in which they are issued.

Removal of fuzes from their warheads is not permitted except at ammunition depots unless there is specific authorization.

Fuzes in rockets which have been fired must be considered armed. Since all the arming mechanism is inside the fuze, there is no method of visually determining whether the fuze is armed or unarmed.

1-15.3 TYPICAL PRESSURE-ARMING, IMPACT-FIRING BASE FUZE. The main external parts of this type of fuze, figure 1-11, are the head, plug, inlet screw, inlet filter, body, and booster magazine. The head and plug contain the copper diaphragm, gasket, and rear portion

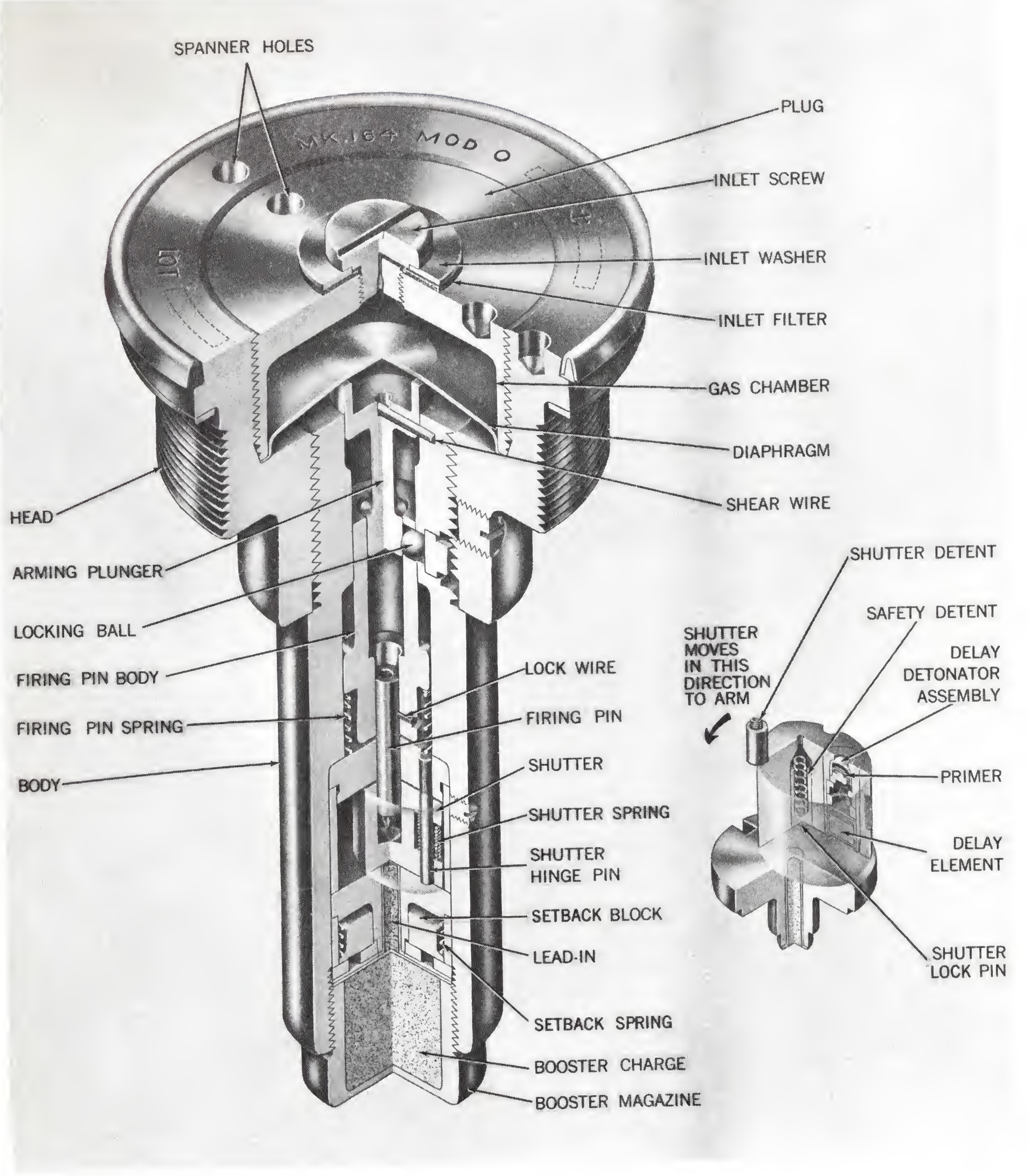


Figure 1-11. Typical Base Fuze (Pressure-Arming, Impact-Firing), Unarmed, Sectional View.

of the arming plunger. The aluminum arming plunger is held in place by a plunger shear wire.

The arming plunger holds a locking ball in a position which secures the firing pin body and firing pin in the forward position, compressing the firing pin spring. While in the forward position, the firing pin extend through the firing pin guide and into a cavity in the shutter.

While the shutter cavity is engaged by the firing pin, the delay detonator assembly is out of alignment with the tetryl booster lead-in and the firing pin. When the firing pin is withdrawn, the shutter spring rotates the shutter, bringing the explosive elements in line.

Since the firing pin must not completely rupture the cover of the percussion primer, the firing pin is designed to shoulder against the face of the detonator case. Thus, the firing pin will only enter the proper distance into the primer.

To avoid crushing the detonator case by the weight of both the firing pin and firing pin body, the firing pin is secured in the firing pin body by the firing pin lock wire. On heavy impact, the inertia of the firing pin body shears the lock wire and the two parts telescope.

Gas from the burning rocket motor enters the pressure chamber through a small opening in the inlet screw. Debris in the gas is filtered out by the inlet screen. The buildup of gas pressure is delayed by the small opening until approximately half of the propellant is consumed.

When pressure in the gas chamber reaches 275 to 325 psi, the diaphragm collapses, forcing the arming plunger down and shearing the plunger shear wire. Movement of the arming plunger releases the locking ball, which frees the firing pin body. The firing pin attached to the firing pin body is withdrawn from the shutter by the firing pin spring and the inertia of the firing pin body.

Setback also pushes the setback block and shutter lock pin against the setback spring. The shutter lock pin engages the detent hole in the shutter and prevents the movement of the shutter to the armed position, after the firing pin has been withdrawn.

When acceleration of the rocket has ceased, the shutter lock pin attached to the setback block is pushed forward by the setback spring, which has been compressed, and also by the safety detent. The shutter, in turn, is rotated into the armed position by its spring. The shutter then is locked in the armed position by the shutter detent.

On impact, the inertia of the firing pin body drives the firing pin forward, initiating the percussion primer. The primer initiates the black powder delay element. The delay element then initiates the tetryl lead-in and the tetryl booster which detonates the main charge of the rocket warhead.

This type of fuze is detonator safe. In the unarmed position, the detonator assembly is out of alignment with the rest of the explosive train. If the detonator assembly functions prematurely, the force of the detonation is dissipated upward through a hole in the firing pin guide and away from the rest of the explosive train.

Because of the controlled admission of gas from the rocket motor to the fuze pressure chamber, the first stage in arming does not occur until approximately one-quarter to on-half of the rocket propellant burning time has passed. Thus, if the rocket motor fails before it leaves the launcher, the fuze should not arm. Arming is not completed until after acceleration has dropped considerably. The burning distance, and therefore the arming distance, will vary with atmospheric temperature.

Since it is impossible to tell whether or not the fuze is armed from an exterior examination, the following precaution should be observed. If, for any reason, it is thought that the fuze may be armed, it should be treated as a hazardous item and disposed of accordingly. No attempt

should be made to remove the fuze from the warhead.

1-15.4 TYPICAL DECELERATION-DISCRIMINATING BASE FUZE. This type of fuze, figures 1-12 and 1-13, consists of a steel body, a booster magazine, and a gas chamber plug. Inside the after end of the body is a double chamber formed by the plug, baffle cup, and diaphragm.

Gas from the rocket motor enters these chambers through the inlet valve. The diaphragm prevents the gas from entering the remainder of the fuze body cavity. Beneath the diaphragm, an aluminum arming sleeve is held in position by a shear wire. A pin through the arming sleeve engages a rotor, which is spring-loaded by a torsion spring.

Axial slots inside the rotor engage the arming sleeve pin and also the detonator plunger pin of the detonator plunger. Two trigger block locating pins pressed into the trigger block engage the rotor. A spring-loaded firing pin is contained in the detonator plunger; attached is the detonator case containing the primer and the detonator case lead-outs.

The detonator plunger assembly must be rotated 90 degrees and

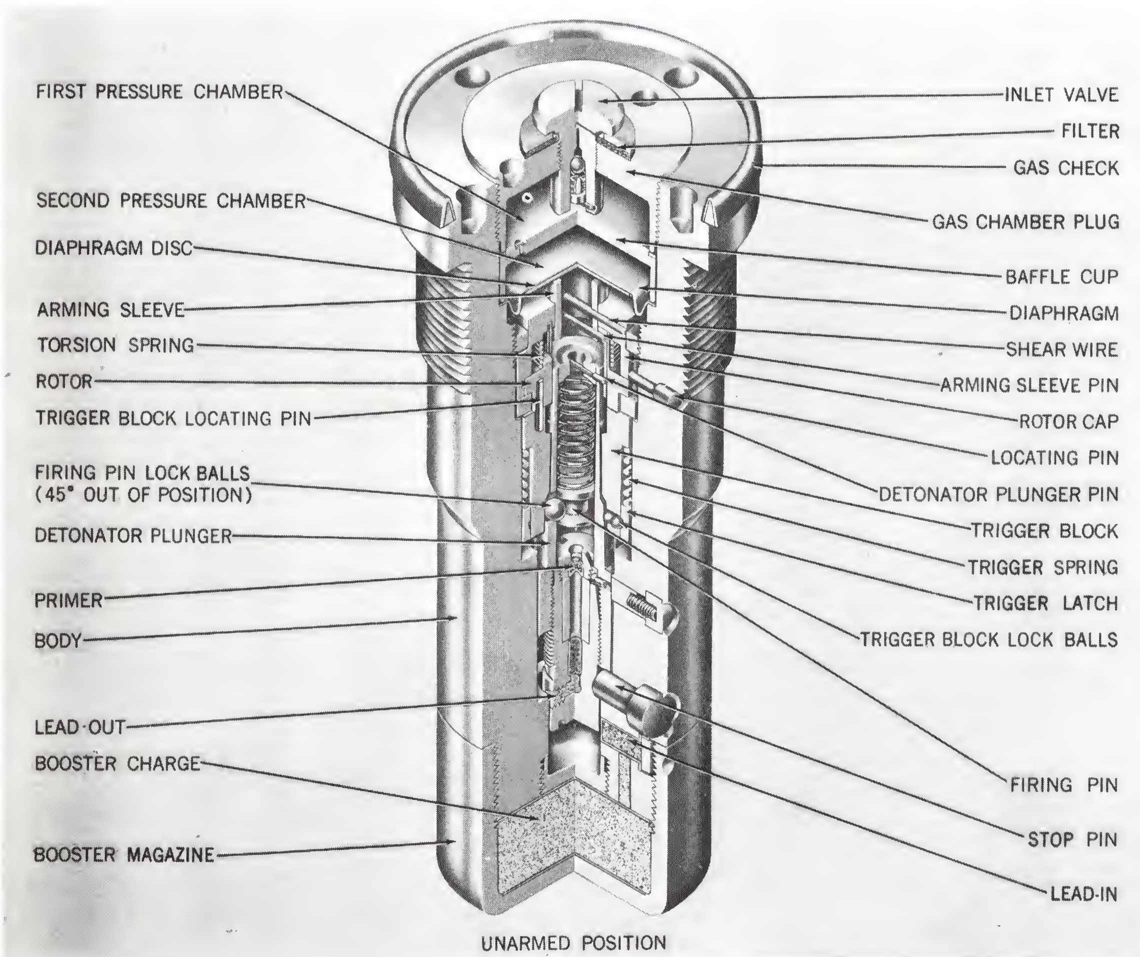


Figure 1-12. Typical Deceleration-Discriminating Base Fuze, Unarmed, Sectional View.

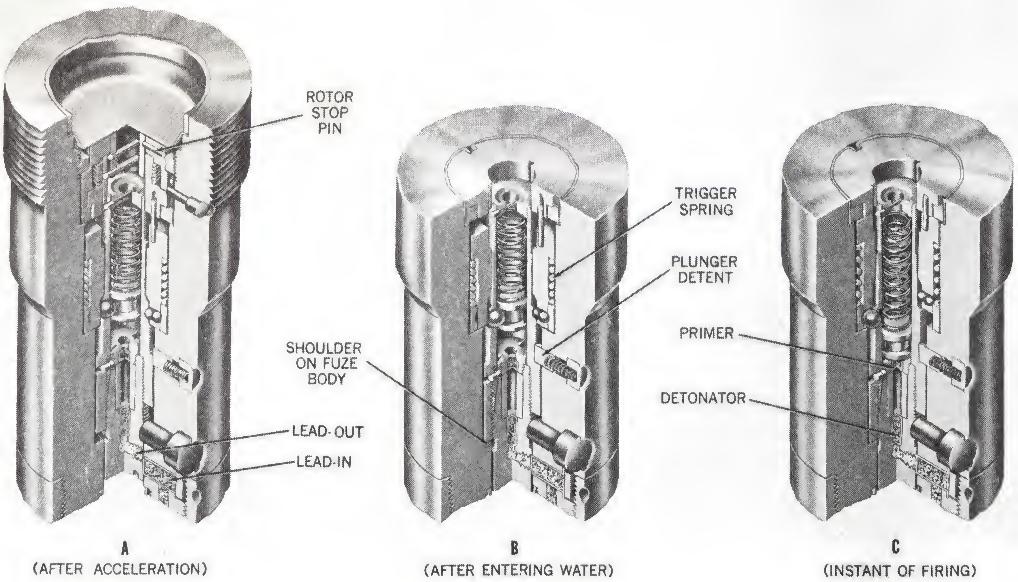


Figure 1-13. Typical Deceleration-Discriminating Base Fuze Mechanism: (A) After Burning of Propellant, (B) After Impact With Water, and (C) At Instant of Firing.

moved forward to line up the lead-outs with the lead-ins. In the unarmed position, the detonator plunger assembly is restrained from moving forward of the stop pins in the side of the fuze body. A locating pin in the fuze body serves to orient the detonator plunger assembly and rotor cap with respect to the fuze body.

The spring-loaded firing pin is held cocked by four lock balls which are held in place by the trigger block. The trigger spring is compressed between the trigger latch and a shoulder on the trigger block. The trigger block lock balls bear against the detonator plunger and a groove in the trigger latch. A closing plug closes the end of the body cavity.

Fuze arming is initiated by gas from the rocket motor, which enters through the inlet valve. Residue associated with burning of the propellant is filtered out by the wire mesh of the inlet valve filter. Gas pressure forces the inlet valve ball to compress the inlet valve spring, permitting the gas to enter the first pressure chamber. The gas then is allowed to flow at a slower rate into the second pressure chamber through a smaller orifice drilled in the baffle cup.

When the pressure in the second chamber reaches a value of approximately 525 psi, the diaphragm collapses, forcing the arming sleeve forward and shearing its shear wire. The time needed for the gas pressure to reach the arming pressure value of 525 psi is dependent upon the pressure of the propellant gases in the rocket motor which, in turn, depends upon the initial propellant temperature.

When the shear wire has been sheared, the arming sleeve and rotor are free. The torsion spring then can turn the rotor. The rotor, which also engages the detonator plunger pin and the trigger block (by means of the trigger block locating pins), revolves the detonator plunger-trigger block assembly 90 degrees where it is stopped by the rotor stop pin (see figure 1-13).

The lead-outs in the detonator case are lined up radially with the lead-ins in the fuze body, but are still out of alignment along the longitudinal axis of the fuze. Slots in the end of the detonator plunger and stop pins in the body also are aligned by the rotation. The detonator plunger-trigger block assembly now is free to move forward under the force of creep until the trigger block rests against the shoulder in the fuze body.

Friction of the firing pin lock balls on the trigger block prevents the detonator plunger from moving farther forward until impact. Upon impact, the detonator plunger moves forward until it is stopped by the shoulder in the fuze body (see figure 1-13).

At this point, the slots of the detonator plunger engage the stop pins, the detonator case lead-outs are aligned with the body lead-ins, and the plunger is locked by the plunger detents. At the same time, the trigger block lock balls fall in behind the shoulder on the detonator plunger, releasing the trigger latch which was formerly locked with respect to the trigger block. This renders the trigger spring active. It is compressed between the shoulder on the trigger block and the shoulder in the fuze body cavity, and tends to force the trigger block toward the rear.

As long as the round retains its velocity, the inertia of the trigger block keeps the trigger spring compressed. As soon as velocity declines to the design limit, the spring overcomes setback forces while the inertia of the trigger block forces it to the rear, releasing the firing pin lock balls. The balls move outward and release the spring-loaded firing pin, figure 1-13. The firing pin initiates the primer which, in turn, initiates the detonator, the lead-outs, the lead-ins, and the booster charge.

This fuze is detonator safe. The detonator case lead-outs and the body lead-ins are out of alignment until after arming and impact with the water. The lead-outs and lead-ins are both longitudinally and laterally out of alignment until after the first two arming steps have taken place.

Because this fuze becomes quite sensitive after arming is completed and can be detonated rather easily, the following precautions should be observed. If an extremely light impact has occurred after the forces of gas pressure, spring, and creep have had their effect, the fuze may be fired by an additional slight jar. A fuze which remains unfired after heavy impact also is very sensitive, since it may be expected that the firing pin has struck the detonator, and subsequent friction between the firing pin and detonator may fire the fuze. In any event, the fuze or fuzed round should be considered hazardous and disposed of accordingly.

1-16 ROCKET DETAILS AND CONTAINERS

1-16.1 DETAILS. Rocket details are devices used in packaging and handling of the components. They are not attached to the rocket when it is in flight. They include such items as thread protectors on heads and motors, spacers in fuze holes to secure auxiliary boosters prior to installation of fuzes, short circuiting

clips for electrical connectors, and fuze safety wires. These details are illustrated in the applicable chapters herein.

-16.2 DETAILS PECULIAR TO OLDING-FIN ROCKETS

-16.2.1 Head Shipping Support. This netal cup, figure 1-14, is assembled n the forward end of motors when hipping conditions require it. The upport is currently used when war-eads and motors are shipped in he same container, with the nose nd of the warheads seated in the orward end of the motors. The ead shipping support, which is held n place by three detents, protects the hreads in the forward end of the notor.

Since the warheads are already ttached to the motor, no head ship-ping support is required for 2.75-inch FFAR shipped and stored in Aero 7D hipper-launcher container packages.

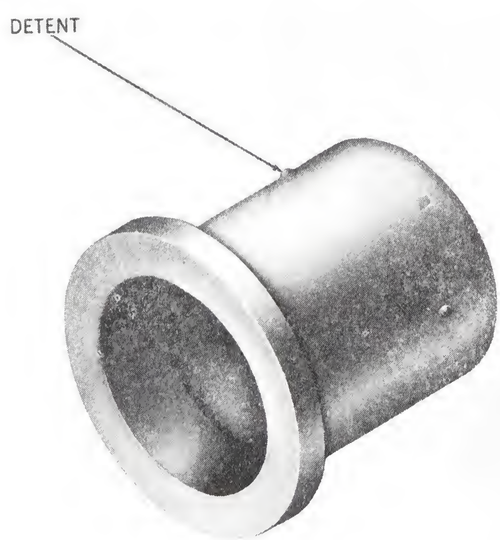


Figure 1-14. Head Shipping Support for 2.75-Inch FFAR.

1-16.2.2 Fin Protector. This elongated steel can, figure 1-15, is placed over the fin assembly to protect it during shipping and storage. The fin protector is not used when motors are shipped in combination launcher-containers. The protector is secured to the motor by detents which fit into the groove on the exterior of the nozzle plate. Riveted to the inside of the after end of the protector is a contact spring that presses the insulated contact disc on the fin retainer (see figure 1-2), thereby short-circuiting the firing circuit of the igniter. This prevents accidental firing of a motor by RADHAZ during transit and storage.

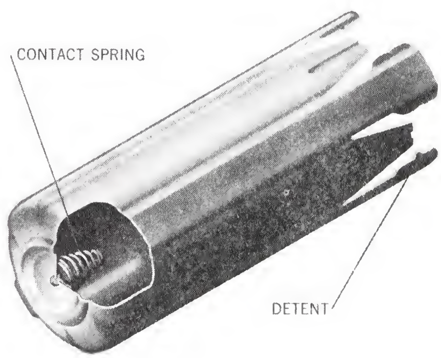


Figure 1-15. Fin Protector for 2.75-Inch FFAR, Cutaway View.

1-16.3 CONTAINERS. Current packaging for rocket components includes wood and metal boxes, metal cans, and paper and metal tanks, figures 1-16 and 1-17. Inside the containers are cradle blocks or spacers that secure the items. Rocket fuzes may be shipped in this manner or in individual, sealed cans. The outer container for fuze cans usually is a wood box.

Unit loads of the various types of containers, figure 1-18, are assembled for handling with powered equipment.

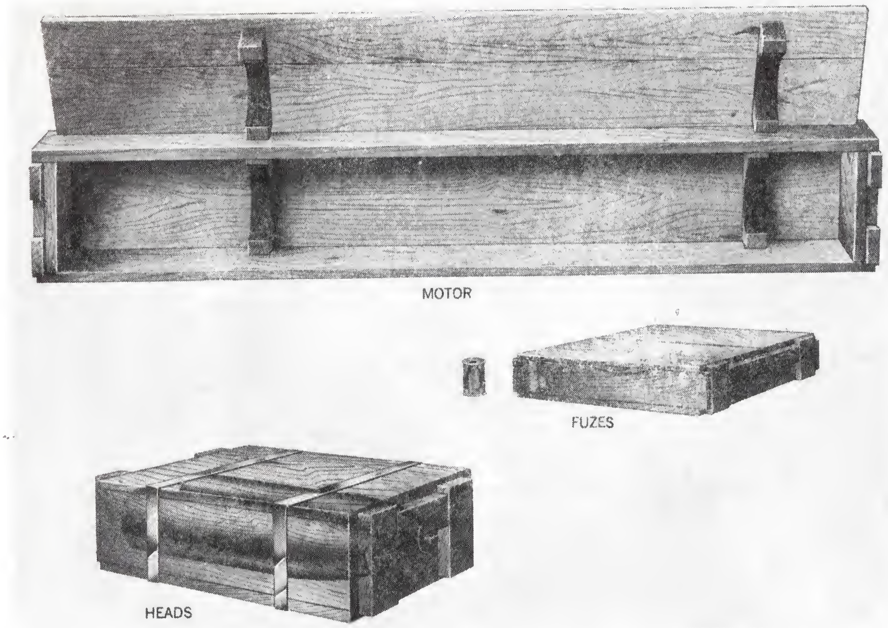


Figure 1-16. Typical Wood Containers for Rocket Components.

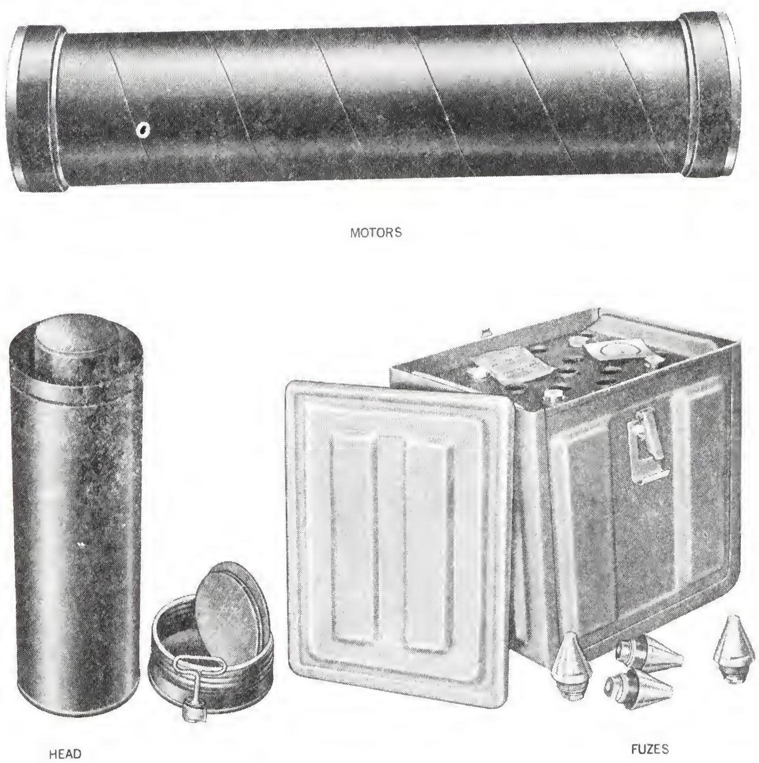


Figure 1-17. Typical Paper and Metal Containers for Rocket Components.

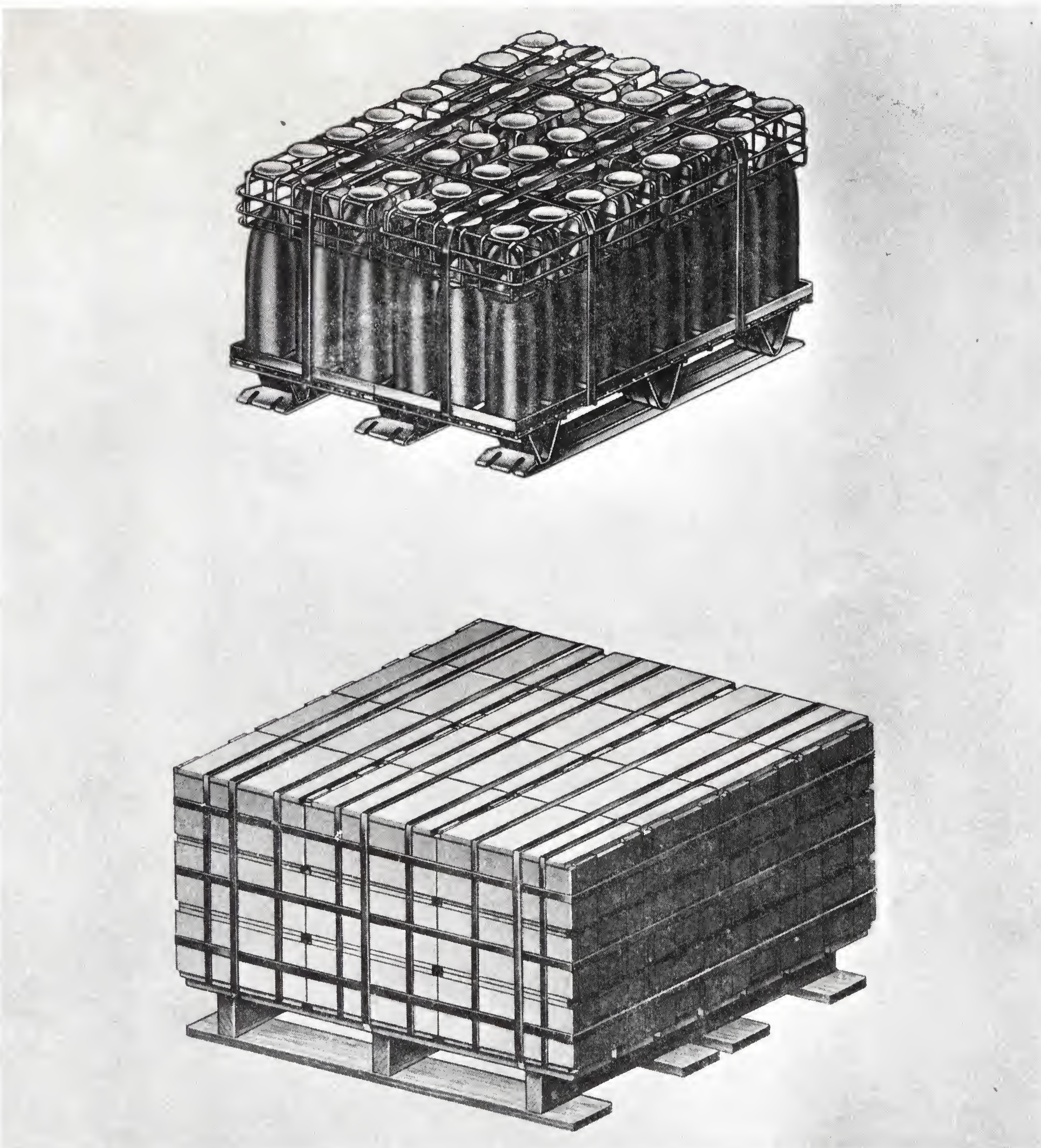


Figure 1-18. Typical Unit Loads of Rocket Components, Showing a Unit of Unpackaged Heads and a Unit of Packaged Heads.

If the unit load is one of motors with separate fin assemblies, these fin assemblies are included in the load. Some special unit loads are assembled by means of metal frames from items which are not packaged. Such metal frames and their accompanying pallet adapters should be stowed, after breaking out the items in the load, and returned to an issuing ship or station.

1-16.4 CONTAINERS PECULIAR TO FOLDING-FIN ROCKETS. The following containers are currently

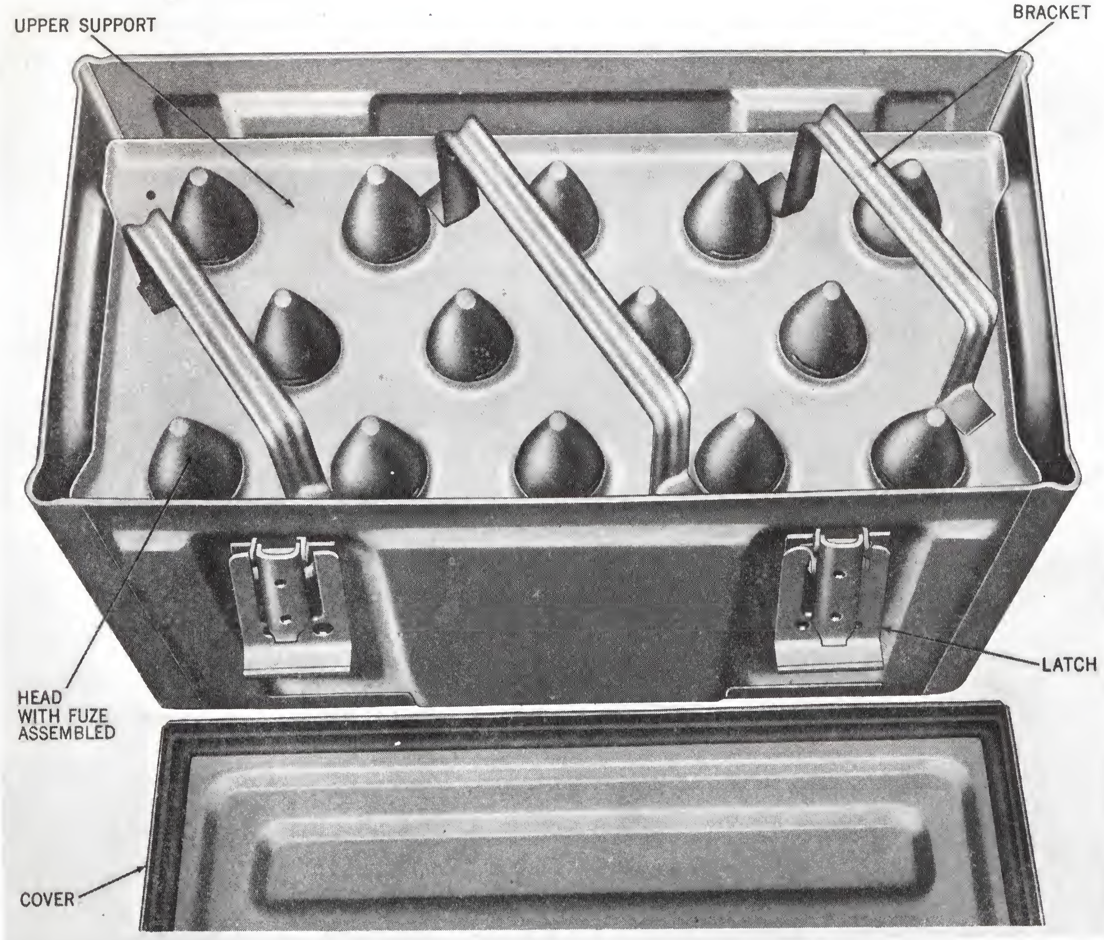


Figure 1-19. Typical Head Container for 2.75-Inch Rockets, Cover Removed.

used to package 2.75-inch rockets and components.

1-16.4.1 Head Containers. Steel ammunition boxes, figure 1-19, are used to package warheads assembled with their fuzes. These boxes are converted 20-mm cartridge containers; they are fitted with a lower support to secure the base of the warheads and an upper support to secure the nose section of the warheads. Brackets on the upper support serve to hold the upper support in place while the cover is on the box. The cover is secured to the box by latches.

To remove the warheads from the container, release the latches and remove the cover, remove the upper support by lifting on the brackets, and lift out the chipboard pad under the upper support. The warheads may then be taken out. The box contains 14 warheads.

This type of container should be saved and returned to an ammunition depot for reuse.

1-16.4.2 Warhead and Motor Containers. Reusable steel containers,

figure 1-20, for shipping four complete rounds provide cushions on all sides of the rockets. A locking handle compresses gaskets on the cover against upper edges of the tubes in the body of the container to seal the assembly. In this type of container, a wire extractor is fixed to the motor of each round to assist removal of the round from the container. The bent end of the extractor is inserted in a hole near the forward edge of the fin protector. Pulling on the ring of the extractor will free a motor which might have become struck against the plastic buffers on the inside of the container. The extractors should be replaced inside the container before it is stored for return to an ammunition depot.

This container may be used for ready-service stowage—under the special conditions and limitations imposed on this type of stowage. After the warhead is threaded to the motor, the round is placed in the container so that the motor of the assembled round is in the same location in the container that it occupied before removal and assembly. The extractor also occupies the same position in the container that it did before removal. The warhead on the assembled round will be in the same approximate location, but it will be pointing in the opposite direction.

In order that the personnel of Naval activities and adjacent public and private property might be reasonably safe from injury or destruction from possible explosions or fires, these containers should be stored in stable piles and stacked in such a manner as to ensure against toppling or collapse of the piles.

In addition to those containers shown, there are presently in service several shipper-launcher-container packages: the Aero 6A, 7D, and LAU-10/A. The first two are

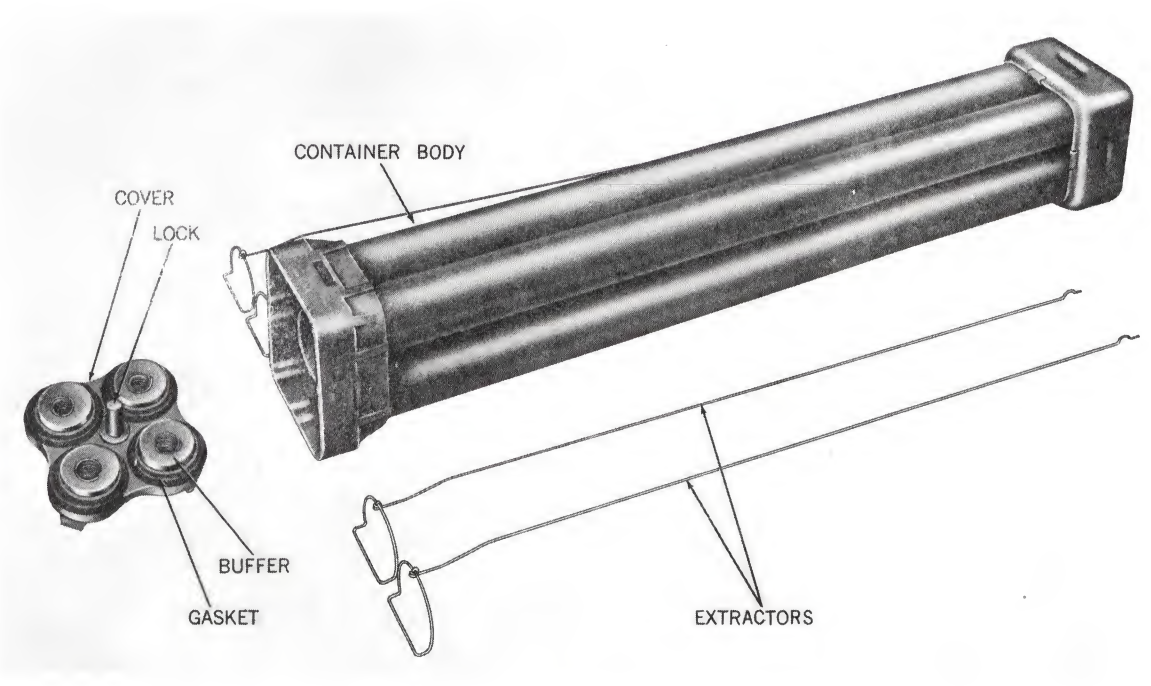


Figure 1-20. Container for Heads and Motor Shipped Together, Cover and Extractors Removed.

used with the 2.75-inch FFAR. All of these may not have RADHAZ protection, refer to 16-1-529 for instructions. The last is used with ZUNI, a 5.0-inch FFAR. The Aero 6A and LAU-10/A shipper-launcher-container packages are used to store seven 2.75-inch and four ZUNI rocket motors, respectively. The Aero 7D launcher is designed to carry from manufacture to service firing, 19 READY-TO-FIRE 2.75-inch aircraft rockets. Warheads and fuzes for rockets used with the Aero 6A and LAU-10/A launchers are provided for as described in paragraph 1-16.4.2.

Since the function of shipper-launcher-container packages is manifold and since function varies from one configuration of launcher to another, this publication treats them as separate rocket components. Particulars for the various configurations of shipper-launcher-container packages are given in chapter 7.

1-17 ROCKET OPERATION

1-17.1 LAUNCHING. Launchers are used to hold and fire rockets. Various types are employed, depending on the aircraft and the rockets to be fired. Single, pylon-type launchers are not treated in this publication. Rockets must be fired only from the launchers authorized.

Rockets with electrical connectors make contact by plugging into a receptacle on the launcher so that the igniter leads are joined to the firing circuit in the aircraft. Some rockets are secured to the aircraft by the suspension buttons or bands which fit into slots and release devices on the launcher. The rocket is fired from the launcher when the firing circuit in the aircraft is energized.

1-17.2 PROPELLANT CHARACTERISTICS. The burning in a solid-propellant grain proceeds perpendicularly inward from all ignited surfaces at a rate determined by the burning propellant pressure in the motor tube and the temperature of th grain. This condition will continue until most of the propellant is consumed. The condition mentioned above is called steady state of flow, steady state, or equilibrium. When t amount of burning surface (and thus pressure) is decreasing, the conditic is known as "regressive burning." I the amount of burning surface and pressure is increasing, the condition is known as "progressive burning."

Propellant grains burn from abo 0.15 to 1.5 seconds, depending on the size, temperature, burning area, and shape. The rate of burning varies directly with the initial temperature of the grain. The velocity at end of burning attained by two rockets of the same type and launched under the same conditions, except for different propellant temperatures at the time of ignition, will be practically the same. However, the rocket launched at 100°F will have attained its peak velocity before the one launched at 40°F. This differen in time required to reach peak velocity will make a difference of a fe mils deflection in the trajectories o the two rockets. The slower burnin motor will have a higher dispersion

Very high propellant temperatures cause such a rapid rate of burning and high pressure that the motor tube may rupture. Very low temperatures cause the grain to burn unevenly, so that spurts of gas are emitted from the nozzles, called "chuffing," or the grain may disintegrate, emitting burning slivers of ballistite. When so fired, the rocket will travel only a short dista

The firing of some rockets is limited to a relatively narrow temperature range compared to that suitable for the firing of guns. The present upper limit for these rockets is about 120°F; the lower limit about –20°F. The 2.75-inch rockets, equipped with motors that are relatively temperature-insensitive, operate satisfactorily between temperature limits of 165°F and –65°F, unless otherwise directed by directions stencilled on the rocket motor. The over-all firing temperature limit for the ZUNI rocket is 165°F and –30°F.

1-17.3 FACTORS AFFECTING TRAJECTORY. Other than temperature, these factors are those associated with the launcher, those associated with the line of flight, and gravity.

1-18 FOLDING-FIN ROCKET OPERATION

1-18.1 GENERAL. The operation of the 2.75-inch and ZUNI rockets is similar to that of other aircraft rockets except for the method of suspension, the igniter circuit, the fin assembly, the propellant grain, and the fuzes. The operation of the fuzes is described in paragraph 1-15; the other factors are treated in the following paragraphs.

1-18.2 METHOD OF SUSPENSION. Because of their folding fins, the 2.75-inch and ZUNI rockets are launched from tube-type launchers. (See chapter 7 and paragraph 1-27.2 of this chapter.) Such a launcher eliminates the need for suspension devices on the rocket itself, except for the groove around the nozzle plate on the 2.75-inch and the forward end of the ZUNI motor. The groove receives a detent latch which is a part of the launcher tube.

1-18.3 IGNITER CIRCUIT. To facilitate firing the 2.75-inch multiple tube launcher, there is no electrical connector assembly as with other aircraft rockets. One lead from the igniter is grounded to the nozzle plate (refer to figure 3-2); the other lead terminates on the contact disc at the extreme after end of the motor (refer to figure 3-3). The launcher firing circuit has an insulated terminal which touches the contact disc. The launcher latch carries the current from the nozzle plate to complete the circuit. When the circuit is energized, current flows through the launcher insulated terminal, through the contact disc, through the igniter, and returns via the grounded lead to the nozzle plate and the launcher latch. When the rocket fires, gases expelled from the burning propellant soon blast off the nozzle disc and fin retainer with its contact disc and igniter lead.

1-18.4 FIN ASSEMBLY FUNCTIONING. When the motor is fired, figure 1-21, the fin retainer is blown off, freeing the fins. Gas pressure from the motor forces the piston and crosshead aft, pushing the crosshead against the heels of the fins. The launcher tube restrains the fins, with the fins exerting a force of about 2 pounds per blade against the tube.

As soon as the round clears the launcher, the crosshead forces each fin open to an angle of slightly less than 90 degrees with the axis of the motor tube. Then, air resistance and setback forces return the fins to an angle of 45 degrees, in which position the heels of the fins rest against the fully extended crosshead. The crosshead and fins stay in this position throughout the remainder of the flight.

The 5.0-inch folding-fin aircraft rocket (ZUNI) uses a different method

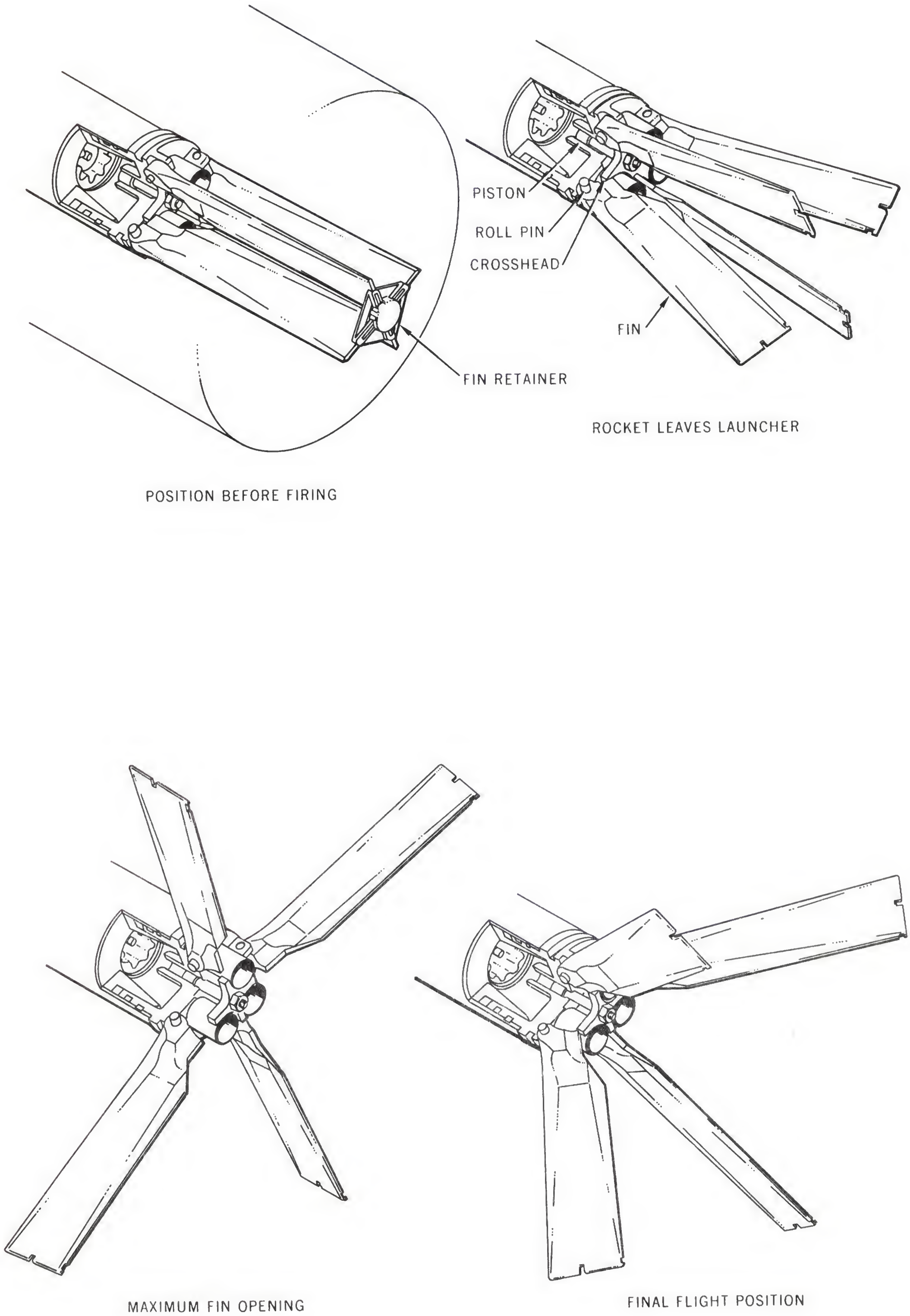


Figure 1-21. Phases of Fin Assembly Functioning, 2.75-Inch FFAR.

of fin extension. Where the 2.75-inch rocket fins are extended by piston-crosshead action, ZUNI fins are blast operated. The heels of ZUNI fins are installed to lie over the nozzle cone. The first gases from the motor kick the fins open to latch on ratchet pawls. A small plastic fin retainer disc holds the fins closed before motor firing.

After the rockets are fired, the launcher package normally is jettisoned by the aircraft, although some configurations of launcher packages are reusable. (See chapter 7.) The shipping end pans and motor retaining plugs which were removed before assembling the warheads and loading the launcher package on the aircraft should be stored and returned to an ammunition depot for reuse.

1-18.5 PROPELLANT GRAIN. The propellant grain in the 2.75-inch and ZUNI motors is made of a new composition which keeps the grain relatively insensitive to temperature changes. The trajectory of rounds with this type of propellant will be more stable and predictable than that of rounds having ordinary propellants.

1-18.6 THE LAUNCHER. The principal factor here is the length of the guide rail. Since the initial velocity of an aircraft-fired rocket is the same as the velocity of the aircraft, the launcher may be very short with no adverse effect on accuracy.

1-18.7 THE ROCKET ITSELF. The principal factors here are mechanical misalignment and gas misalignment. Mechanical misalignment is an effect resulting from the inherent imperfections in manufacturing and assembling the rounds. The axis of the nozzle is not likely to be exactly in line with the axis of the motor tube. The same discrepancy is likely in a multiple-nozzle plate assembly, resulting from axes of the nozzles (see figure 1-5).

Since the motor usually is attached to the warhead by a threaded joint, it is not likely that the axis of the warhead and the axis of the motor are both coincident with the axes of their respective threads. By regulating tolerances in manufacture, these errors can be reduced to a low value but can never be eliminated.

In an assembled rocket, the distance between the prolonged axis of the nozzle and the center of gravity of the round is known as the mechanical misalignment. It usually is a few thousandths of an inch.

Gas misalignment stems from the fact that gas does not flow through a nozzle uniformly. If the flow were perfectly symmetrical and concentric with the nozzle axis, the line of thrust would coincide with the axis. Experiments, however, show that the line of thrust deviates from the nozzle axis by a small angle which is unpredictable in direction and magnitude. The causes are obscure and are presumably to be sought in the dynamics of the flow of gas down the motor tube and through the nozzle. It does not lend itself to easy measurement. The distance of the line of thrust from the center of gravity, owing to the action of the jet, is the degree of gas misalignment.

In any particular rocket assembly, the total misalignment is the vector sum of the mechanical and the gas misalignment.

Stable flight is accomplished by the fins on the motor tube. At launching, the restoring moment of the fins is dependent on the velocity of the aircraft. Important as it is, the immediate reaction of the rocket to "being on its own" represents but a few milliseconds of total

trajectory time. Instability of the rocket during this period is not critical because of its rapid acceleration and the high restoring moment of its fins.

1-18.8 WINDS ALONG THE LINE OF FLIGHT. The total effect of a crosswind is determined by the effects during burning and after burning. During burning, a crosswind tends to turn a fin-stablilized rocket into the wind. After burning, a rocket with fins will drift downwind, with its nose pointing slightly into the wind. Also, crosswinds can be generated by not having the axis of the aircraft in line with the direction it is going.

1-18.9 GRAVITY. This force accounts for the drop of the rocket trajectory. Although the effect of gravity is constant from the moment of launching until the round strikes its target, the effect is more apparent after the propellant has burned out and gravity is the main force acting on the rocket.

Figure 1-22 illustrates the phases in the flight of a typical aircraft rocket. First, the igniter is fired by the electrical firing circuit in the aircraft. The rocket is still attached to the launcher because sufficient thrust has not been generated to propel the rocket away from the aircraft; a leaf-spring detent latch retains the rocket in each launching tube until thrust loads of 10 to 15 g are applied.

When the case of the igniter has been ruptured by pressure from the rapidly burning igniter mixture, the propellant grain begins to burn from the heat of the igniter combustion. (Burning takes place on the uninhibited surfaces of the propellant grain.) The terminal of the electrical connector which was connected to the igniter leads is blown out of its seat in one nozzle seal by the mounting pressure in the motor tube. The other nozzle seals also are blown out.

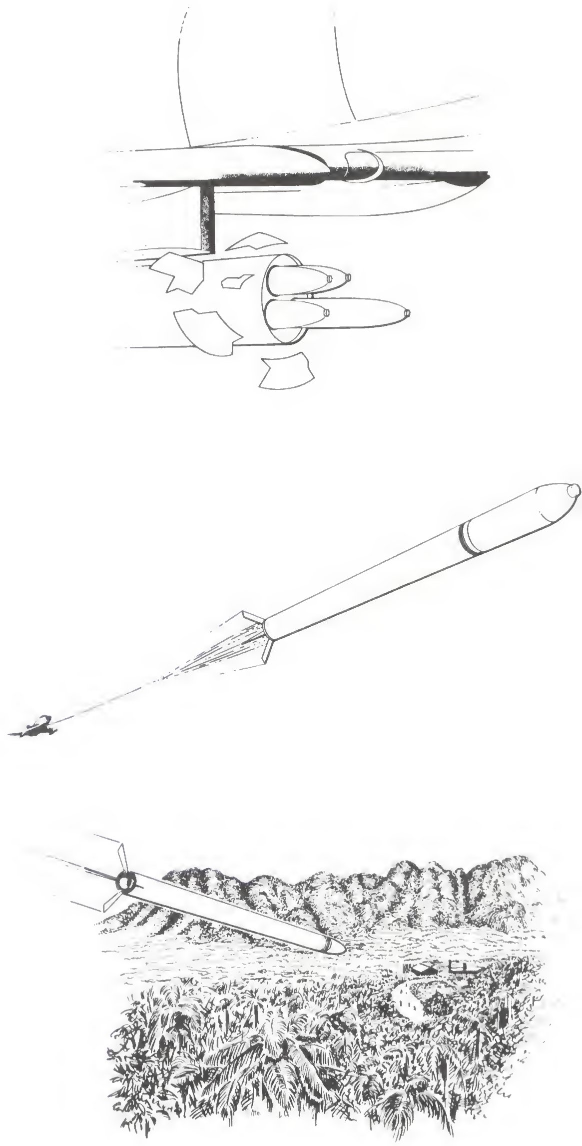


Figure 1-22. Phases in the Flight of a Typical Aircraft Rocket.

1-18.10 LAUNCHING FOLDING-FIN AIRCRAFT ROCKETS. Folding-fin aircraft rockets launched from package launchers have approximately the same firing characteristics as the fixed-fin rocket. However, the metho

and characteristics of rocket ignition, takeoff, and fuze armament differ.

1-18.11 ROCKET IGNITION. An intervalometer mounted on a bulkhead of the launcher receives power for the rocket ignition system from the 28-volt DC armament circuit of the aircraft. This 28-volt DC must pass through a 5-ohm resistor placed in series with the intervalometer. If this resistor is not in the firing circuit the 7- and 19-round 2.75-inch FFAR rocket launchers will salvo, and also the time interval between rounds for the 2- and 4-round ZUNI launchers will be delayed by approximately 20 milliseconds. On launchers where no option between ripple and single fire exists, a shunt-fuze intervalometer is used in the circuit in conjunction with the 5-ohm resistor. The firing impulse is then distributed to the rockets in 10-millisecond intervals by the 2.75-inch FFAR intervalometer and 98-millisecond intervals by the ZUNI intervalometer. Contact with the launcher circuitry is made in either of two locations through a five-prong Cannon plug.

Launchers which provide an option of single or ripple fire are equipped with a rotary-type relay intervalometer and a fire selector switch. When this type of launcher is used on aircraft not equipped with a cockpit fire selector switch, the desired method of firing, ripple-optional or single, must be selected prior to takeoff. On aircraft equipped with a cockpit fire selector switch, the launcher selector switch must be oriented with the cockpit switch, after which the pilot will be able to ripple or single fire the rockets at his discretion. When the optional-fire configuration of launcher is used for ripple fire, the intervalometer converts the firing pulse into a ripple rate with a predetermined delay interval. If single fire is employed, the intervalometer relay rotates only one position each time a pulse is received. Here again, contact is made with the individual rockets through a detent latch in each rocket tube.

1-18.12 LAUNCHING. A folding-fin rocket receives current, initiating its igniter mixture. Igniter combustion provides sufficient heat to start propellant burning. When enough thrust is generated by the burning propellant grain to overcome the detent load, the rocket leaves the launcher. (See paragraph 1-18 for folding-fin rocket operation.) Rocket exhaust disintegrates the aft launching fairing. The rocket warhead pierces and fragments the forward launcher fairing. Subsequent rounds are unobstructed. In most instances the launcher is jettisoned by the pilot after completion of firing. However, some launchers, notably the LAU-10/A launcher used with ZUNI, have a service life of many salvos and are not jettisoned unless it is tactically necessary. A separate electrical impulse is required to jettison the launcher.

1-18.13 FUZE ARMAMENT. Unlike fuzes used with many aircraft rockets, folding-fin rockets utilize fuzes with no external arming device. (See paragraph 1-15.2 for typical acceleration-arming, point-detonating nose fuze.)

When the propellant completes half its burning, the rocket moves well forward of the aircraft. The nose fuze completes the first stage of its arming. The fuze arming wire is pulled off as the rocket leaves the plane, the nose cap is jettisoned, and the propeller rotates its full number of turns. (See paragraph 1-15.1 for typical air-travel-arming, impact-firing nose fuze.) The base fuze completes one stage of its arming,

as gas from the burning propellant in the motor enters the gas chamber in the rear of the base fuze. (See paragraph 1-15.3 for typical pressure-arming, impact-firing base fuze.) As long as the propellant is burning, the rocket is being accelerated. The round reaches its peak velocity at the end of this burning.

The end of acceleration occurs when the propellant is completely consumed by the burning. The influence of gravity on the rocket trajectory becomes more apparent, and the rocket deflection from the line of launching becomes progressively more pronounced. Both the nose and base fuzes are completely armed, because both acceleration and deceleration of the rocket have taken place. (See paragraph 1-15 for operation.) Soon the rocket will strike the target; the impact will fire the nose fuze, and, if the nose fuze does not function, the same impact will fire the base fuze.

1-19 ASSEMBLY AND DISASSEMBLY OF COMPLETE ROUNDS

1-19.1 GENERAL. Fixed-fin, single-mounted aircraft rockets are not shipped in assembled form because of their steel construction. If ignited from an external source, such as a fire in the magazine, they become propulsive. Some folding-fin aircraft rockets, however, are shipped and stored in shipper-launcher packages. The 2.75-inch FFARs when used with the Aero 7D launcher, are shipped completely assembled in shipper-launcher packages. Rockets thus shipped consist of motors with fuzed warheads attached. Fuzes for these rockets are not separate items of issue. The 2.75-inch FFAR may be shipped assembled because of its aluminum construction. If ignited from an external source (for example, a fire in the magazine), the motor tube ruptures and the propellant grain burns non-explosively, if at all. Similarily, an injury to the rocket tube wall may produce a weak spot, permitting splitting of the motor tube during ignition, resulting in a non-propulsive rocket motor.

In assembling complete rounds, only those combinations of warheads, motors, and fuzes which carry an assembly mark and mod designation, as indicated in chapter 5 or in appendix A of this publication are permitted.

The general preparations and procedures for assembling and disassembling rockets, which are not shipped assembled, follow. The step-by-step sequence for particular calibers or marks is described in chapter 6.

In any operation involving assembly, disassembly, fuzing, unfuzing, cleaning, or painting, the work shall be done in the most suitable location, safely removed from other explosives and away from vital installations. The smallest number of rounds practicable shall be exposed. Only personnel essential to the work shall be in the vicinity. The ideal situation is one in which only one round is worked on at a time and at a location on deck that is remote from all magazines, ready stowage, other ammunition or explosives, and vital installations.

1-19.2 PRECAUTIONS IN ASSEMBLING COMPLETE ROUNDS. Do not assemble or fuze rockets (except for authorized ready-service rounds) until just before the plane is ready to be armed. If this is not practicable, assemble them as near to this time as is feasible. In any case fuzing of rockets which are not authorized ready-service rounds shall be delayed as long as practicable before arming the aircraft.

1-19.3 REMOVING COMPONENTS FROM CONTAINERS. When opening containers, use nonsparking tools. Keep containers in a horizontal position while opening them. During the assembly procedure, keep the rocket warheads and motors in a horizontal position to decrease the possibility of accidents.

If components are in metal tanks or boxes, place in these boxes the details, such as spacers and thread protectors, that are removed from the component in preparation for assembly. Replace the cover on the metal container for return to an ammunition depot. Dispose of wood boxes in accordance with current directives. Enough containers of each type, including wood boxes, should be retained on board for return of faulty components to an ammunition depot.

As the components are removed from their containers, inspect them according to the following instructions. Repair or disposal of defective items is described in paragraph 1-25.

1-19.4 WARHEAD INSPECTION. The procedure for inspecting warheads is as follows:

1. See that the warhead is not dented or cracked. A cracked warhead is hazardous.

2. Verify that the fuze adapter is staked to the warhead. A loose fuze adapter makes the warhead hazardous.

3. See that no threads have been damaged. This includes the threads in the fuze adapter and the motor adapter, if present.

4. See that there is no rust or corrosion.

5. Verify that the warhead contains a base fuze, if required.

CAUTION: Do not attempt under any circumstances, to use a warhead that does not have its base fuze hole closed and gas-checked. Base fuze holes must be gas-checked regardless of whether a base fuze or a steel base fuze hole plug is used, as in the case of Warhead Mk 29 Mod 0.

6. See that the interior of the fuze cavity liner is clean. If necessary, wipe the cavity liner gently with a rag.

CAUTION: Do not attempt in any manner to clean a fuze cavity which does not have a cavity liner.

In some instances, a hardened foreign substance both inside and surrounding the nose fuze cavity may be noticed. This may be present in sufficient quantity and hardness to prevent installation of a nose fuze. The substance is likely to be either NRC (luting) compound; or a heavier type of preservative, such as the wax-base preservative—Compound, Gun Slushing, 14C8 (ORD); or a mixture of the two, indiscriminately applied as a preservative, or propellant grain exudate. The hardened substance must be cleaned from the inside of the fuze cavity liner and the exterior of the warhead immediately surrounding the cavity. It may be cleaned from the cavity liner with nonmetallic brushes, or clean rags dipped in trichlorethylene or alcohol. Trichlorethylene, Fed. Spec. O-T-634a, Type II is nonflammable and is preferred to alcohol. However, it is toxic and care must be exercised to provide adequate ventilation and to avoid exposure to trichlorethylene over extended periods. The exterior of the warhead may be cleaned by scraping

are to be observed during the assembly procedure:

1. Do not remove the fuze safety wires or clip at this time.

2. Do not remove the shorting clip from the electrical connector at this time.

3. Do not stand the assembled round on either end.

4. Protect the fins from damage during and after assembly.

1-19.10 DISASSEMBLY. Undamaged rounds are ordered disassembled by the officer in charge of the firing operation. Damaged rounds or rounds with armed or partially armed fuzes will be disassembled by explosive ordnance disposal personnel. If none are available, disassembly or disposal of rounds is ordered by the officer in charge.

Inspect rounds for defects before disassembling them into their component fuzes, warheads, and motors. In general, to disassemble rounds which are not defective, follow the assembly steps in reverse order. The step-by-step disassembly procedure for specific rockets is in chapter 6.

1-19.11 PRECAUTIONS DURING DISASSEMBLY. The following precautions are to be observed during the disassembly procedure:

1. It is important that the fuze wrench designed for use with any particular fuze be used to remove the fuze from the round. Use of an improper wrench may engage the wrong holes, flats, or slots, and result in arming, functioning of, or damage to, the fuze.

2. If a fuze adapter becomes loose while removing the fuze, stop the operation. This is a defective round and is not to be repaired aboard ship. If grains of explosive are lodged between the adapter threads and warhead threads, unscrewing of the adapter may pinch and initiate the explosive.

3. Do not remove base fuzes, base plates, or nose fuze adapters from rocket warheads at any time.

4. No disassembly of rocket motor components as shipped is authorized. The rocket motor propellant grain is not to be removed from the motor tube except as authorized by Bureau of Naval Weapons directives.

5. Fuzes or firing mechanisms for rockets shall not be removed (except nose fuzes), disassembled, repaired, or in any way altered except as provided by special instructions from the Bureau of Naval Weapons.

6. Upon removal of components from the round, inspection of those parts of the components which could not be inspected when the round was assembled must be made before the components can be returned to stowage.

1-20 LOADING AND UNLOADING ROCKETS ON AIRCRAFT

The procedure to be followed in loading and unloading rounds depends on the particular launcher which is being loaded. This publication does not treat airframe-mounted launchers; however, it does concern itself with shipper-launcher packages, such as those described in chapter 7. The following practices in loading should be observed, regardless of the type of launcher.

1-20.1 LOADING. The following procedure is to be followed when loading rockets on the launcher:

1. In warm weather, the magazine temperature may be used as the motor temperature if a thermometer has been

or brushing with spark-proof tools and brushes.

Cleaned and dried fuze cavities of fuzes being returned to storage should be coated with a thin film of bearing grease MIL-G-16908. Avoid placing an excessive amount of grease in the cavity and on the threads; only a thin film is required.

1-19.5 MOTOR INSPECTION. Inspect the motor carefully and see that:

1. The motor is not dented or deeply scratched.

2. The safety short-circuiting clip or wire is in place on the electrical connector plug.

3. The front and rear closure discs, and nozzle closures are in place.

4. The fins are not bent or broken.

5. The electrical connector is not broken or the insulation damaged.

6. There is no rust or corrosion.

1-19.6 FUZE INSPECTION. The following procedure is to be used when inspecting the fuzes:

1. Verify that the fuze air vanes are not bent and that the body is not dented. Fuzes that are damaged, or that have loose or missing safety devices, or fuzes that are partially or fully armed MUST be considered hazardous.

2. See that the safety wires and pins, if used, are properly in place.

1-19.7 TOOLS. No special assembly kits are currently issued for aircraft rockets. Tools which should be available include strap wrenches, fuze wrenches, the special wrench for the fuze being installed, and applicable spanner wrenches. A utility spanner wrench, figure 1-23, is issued for certain calibers. A fuze wrench, figure 1-23, is included in every

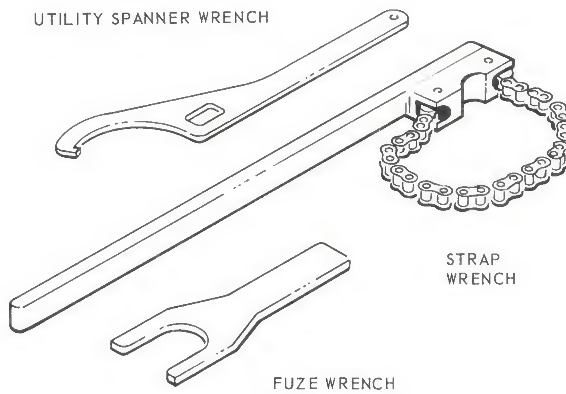


Figure 1-23. Special Rocket Tools: Utility Spanner Wrench, Typical Fuze Wrench, and Strap Wrench.

tenth box of fuzes, in addition to the original issue to a ship. Only this wrench should be used on the fuze being installed or removed. The spanner wrenches, figure 1-23, are designed for removing shipping plug and caps, and for threading the warhead to the motor in a particular caliber of rocket. These special fuze and spanner wrenches are described in chapter 6. When shippe launcher packages are used, the spec tools described in chapter 7 must be available,

1-19.8 ASSEMBLY. The step-by-ste assembly procedures for specific rockets are in chapter 6.

Generally, fuzing procedures, assembly procedures, and precaution ary measures described apply to the 2.75-inch and ZUNI FFARs. Howeve by nature of their design and capabil- ities, certain procedural distinctions must be made for these rockets. Pro cedures used with these rockets and their launcher packages are provided in chapters 5 and 7.

1-19.9 PRECAUTIONS DURING ASSEMBLY. The following precautio

in the magazine for 10 minutes or more. If the temperature of the rocket exceeds the safe temperature limits, load rockets from another magazine, after checking their temperature in the same way. Rockets should be maintained within the prescribed temperature limits for about 6 hours if they have been exposed to higher temperatures for 1 hour or more.

2. Do not remove the short-circuiting clip on the electrical connector of the rocket motor until just prior to plugging in the connector to the receptacle on the plane. Save the short-circuiting clip for possible reinstallation, in case the rocket is unloaded.

3. Do not plug in the electrical connector until the other necessary steps in loading all rockets on the launchers have been taken; for example, inserting launcher shear wires and nose fuze arming wires. Before plugging in the connector, make certain that the launcher firing circuit is open. Avoid rough handling in plugging in the connector; such roughness causes undue strain and wear on the receptacle. Use a straight push on the connector plug. If the plug feels loose in the receptacle, notify the officer in charge, since a loose connection might cause a misfire. The officer in charge may order replacement of this rocket.

4. After inserting a fuze arming wire, make sure that the fuze safety wire, if one is present, is removed.

1-20.2 UNLOADING. The following procedure is to be followed when unloading unfired rockets from the launcher:

1. Be sure that the launcher firing circuit is open; then unplug the electrical connector. In removing the plug, do not jerk it or pull on the cable. Take hold of the plug and pull straight from the receptacle. Some rounds have been turned in to ammunition depots with the plugs pulled off the cable; an apparent result of rough, hasty handling to attain speed re-arming. Many misfires have been attributed to electrical connectors or receptacles damaged by rough handli

2. Place the short-circuiting cli on the electrical connector.

3. Insert the safety wire or clip in the fuze, and remove the fuze arm ing wire.

4. After unloading the round, inspect it thoroughly for possible dama If the round is to be disassembled for return to stowage, inspect the components as they are disassembled.

1-21 LOADING AND UNLOADING PACKAGE-TYPE LAUNCHERS

1-21.1 GENERAL. Launchers for 2.75-inch and ZUNI FFARs consist of multiple, nested tubes that will ripple-fire or, in some configurations single-fire the rounds. The same methods and precautions used for the handling of other aircraft rockets are applicable to these rockets. Detailed instructions for loading rounds into, and unloading rounds from specific configurations of package launchers are provided in chapter 7. Generally, the following procedure is used.

1-21.2 LOADING. Carefully insert the round into the launcher tube, with the round oriented so that the detent latch in the launcher tube does not strike a fin, until the detent latch seats firmly in the groove on the nozzle plate. Prevent the round from falling back against the rear of the launcher; this will avoid damage to th contact button or the launcher firing contact.

1-21.3 UNLOADING. After ascertain that the launcher firing circuit is ope release the launcher latch and slide

he round out of the tube. Use care in replacing the fin protector.

1-22 LOADING AND UNLOADING ROCKET LAUNCHER PACKAGES ON AIRCRAFT

1-22.1 GENERAL. Detailed instructions for preparing and attaching specific configurations of launcher packages to aircraft are provided in chapter 7. Generally, the following procedure is used.

1-22.2 SHIPPING PACKAGE TO AIRCRAFT PREPARATION. Remove supporting or spare parts and tools from the shipping package. Reinstall the package covers and extend and lock their handles in the carrying position. Open electrical receptacles, depress the shorting button, and install the correct configuration of hanger lug arrangement in the package wall hanger wells. Directions for arranging hangers may be found in the aircraft operating instructions.

1-22.3 LAUNCHER TO PYLON ATTACHMENT. Raise the launcher into position, using the launcher extended locking ring handles, and align hangers with those on the aircraft pylon hooks. On pylons using striker arms, instead of ignition cables, align the launcher contact post with the pylon forward rocket rail slot concurrently with hanger alignment. On pylons not using striker arms, insert the pylon ignition cable plug into the nearest launcher receptacle. Securely latch the bomb hooks and tighten the pylon sway braces. On pylons using striker arms, insert the pylon ignition cable plug into the nearest launcher receptacle. Securely latch the bomb hooks and tighten the pylon sway braces. On pylons using striker arms, rotate the striker arm to its down position. Remove the end cover, rubber shipping retainer, and shipping end from the launcher. When launchers do not contain assembled rounds, as the Aero 6A and the LAU-10/A, screw rocket warheads into rocket motors. Instructions for installing rocket heads are provided in chapter 6.

1-22.4 FAIRING ATTACHMENT. Frangible paper fairings are secured to both ends of each launcher. Fairings of this type have a metal band at their base equipped with lugs and a leaf spring clip. The lugs engage grooves in the center section end rings of the launcher. Rotate the fairing clockwise, until the spring clip drops into position to lock the fairing securely in place.

1-22.5 LAUNCHER ARMAMENT PROCEDURE. On aircraft using striker arms, drop striker arms. On other aircraft, attach the HVAR cable inside the ejector rack. Remove the shorting button from the launcher. Do not arm launcher armament until just prior to takeoff. When possible, hold the launcher shorting button up for pilot observation.

1-22.6 UNLOADING. Some configurations of package-type launchers are jettisoned after firing; others have a service life of many salvos. Detailed unloading instructions for specific configurations of package-type launchers are provided in chapter 7. Generally the following procedure is used.

1. Replace shorting button immediately after return from flight.

2. Remove fairings.

3. Remove rocket warheads from launchers in which rocket warheads are not stored, see chapter 7, and return to magazine stowage.

4. Replace end covers; extend and lock handles in carrying position. Disconnect launcher from aircraft and return to magazine stowage.

1-22.7 DISPOSAL OF MISFIRES. In case a returning plane carries a misfired round, the same procedure for ordinary unloading should be followed. Where launcher packages are used, remove the misfired round as described in the following subparagraphs.

WARNING

A 10-minute interval is to elapse between the last attempt at firing the round and any attempt to remove the round from the launcher. During this period the plane should be pointed in the safest direction possible

When the defective round(s) have been removed, perform the following additional steps:

1. Inspect the electrical connector for damaged insulation on the cable or a damaged plug. If it appears that the electrical connector might have produced a short circuit, this motor should be returned to an ammunition depot. The motor must be tagged with a note indicating the damaged electrical connector.

2. Inspect the nozzle seal(s). If a seal is loose or missing, the igniter is to be considered fired. The motor is to be disposed of by dumping overboard. The dumping shall be in water 500 fathoms deep, at least 10 miles from shore.

3. Remove all rockets from the aircraft and test the firing circuit of the launcher on which the misfire occurred.

WARNING

Do not test the launcher firing circuit until all rockets have been removed from the aircraft.

If a faulty launcher circuit caus the misfire, the rocket may be used again. If the launcher circuit was satisfactory, the misfired rocket, if a service round for operational use, should be disposed of by dumping overboard, as in step 2. Motors for training use which fail to fire on a training flight but show no apparent defect are to be loaded on a differen launcher for a second flight. When such a motor fails to fire the secon time and testing indicates that both the launcher circuits are functionin properly, the motor should be dispo of by dumping overboard.

4. Unscrew the warhead from t motor of the misfired round and inspect the front closure of the motor If the closure is loose, the igniter i considered fired. The motor is to b disposed of by dumping overboard.

1-22.8 REPORTING MISFIRES AND MALFUNCTIONS. All reports are to include the full ammunition lot designation of each motor; for example, RMBF-104-NFCH-52.

For misfires, the following information should be included in the report:

1. Result of testing the launche firing circuit after misfire.

2. Result of examination of the electrical connector for damaged insulation or plug.

3. Result of visual examinatior of the motor nozzle seal and front closure to determine if they were loose or missing.

4. Stowage temperature history of the motor from time of receipt aboard ship.

1-22.9 ACCIDENTS AND INCIDENTS. The following information should be included in the report:

1. Date-Time-Zone description.

2. Location of occurrence.

3. Narrative description of occurrence including type of aircraft and Bureau number (BUNO), aircraft velocity, altitude, type of target, slant range, and dive angle.

4. Number and extent of casualties. Specify whether military, Government, civilian, private contractor employee, or other (specify).

5. Complete nomenclature of explosives involved, including, as appropriate:

(a) Type, Mark, or Mod.
(b) Complete round or assembly lot number and/or serial number (include fuze lot number if applicable).
(c) Federal Stock Number.

6. Quantity of explosives involved, actual or estimated.

7. Issuing activity, date received, and quantity remaining.

8. Damage to property, Government and private.

9. Cause, known or probable. If electromagnetic environment is suspected, include equipments radiating, power output, and distance from accident/incident.

10. Comments as appropriate (recommendations, effect on capability, adequacy of operating instructions/safety precautions, local action to preclude recurrence, request for assistance, etc).

11. Statement on whether or not an investigation will be conducted in accordance with the JAG Manual.

1-23 HANDLING AND SHIPPING

1-23.1 HANDLING. The precautions to be taken in handling rockets are the same as those taken in handling other Navy ammunition. The fundamental instructions follow.

1. Handle all components as little as possible.

2. Instruct personnel who will be involved in the handling as to the nature of the material. Only those men essential for handling should be in the area.

3. Personnel working with chemical rockets should have at hand protective gear. When entering concentrated smoke clouds produced by smoke rockets, men should wear gas masks.

4. No disassembly of basic rocket components is authorized except under instructions from the Bureau of Naval Weapons. This applies to heads, motors, and fuzes.

5. Do not use a circuit continuity tester to check the igniter circuit in a motor aboard ship. The circuit is checked before the motor is placed on board.

6. If dropped from a height exceeding 5 feet, a fuzed rocket warhead (whether or not in a container) shall be returned to an ammunition depot. If return to a depot is not practicable, the warhead shall be disposed of.

The general handling instructions for aircraft rockets apply to the 2.75-inch FFARs, except for the motors. These motors, if dropped from a height of less than 2 feet, should be examined for external damage. If no damage is visible, they may be considered safe for use. Motors dropped from a height of more than 2 feet should be treated as defective items.

1-23.2 SHIPPING. Ordinarily, service-loaded warheads, motors, and nose

fuzes are shipped separately. The exception to this is the 2.75-inch folding-fin aircraft rocket, which is often shipped assembled. When used with the Aero 6A shipper-launcher package (see chapter 7), the 2.75-inch rocket is shipped disassembled; its rocket motors are shipped and stored in the launcher, and its fuzed warhead is shipped and stored as described in paragraph 1-16.3. When used with the Aero 7D shipper-launcher package (see chapter 7), the 2.75-inch rocket is shipped and stored completely assembled.

The 5.0-inch ZUNI folding-fin aircraft rocket is shipped disassembled; its rocket motor is shipped and stored in the LAU-10/A shipper-launcher package (see chapter 7); and its warhead is stored separately as described in the section of this chapter on containers.

Practice rockets, with head and motor unassembled, may be shipped in the same container. Base fuzes are shipped installed in warheads. (Typical containers for rocket components are illustrated in figures 1-14 and 1-15, and shipper-launcher-container packages are described in chapter 7.)

When it is necessary to return components to ammunition depots, use packaging which will afford at least as much protection to the item as did the container in which the item was received.

1-24 STOWAGE

Rocket warheads, motors, and fuzes present different types of hazards. They should be stowed separately whenever possible.

1-24.1 WARHEADS. Rocket warheads loaded with high explosives, which are shipped unassembled with motors in a single tank, shall be stowed in magazines aboard ship similar to primary projectile magazines, as defined in OP 4 and OP 5. Stowage arrangements are to be in accordance with rules in OP 4 or OP 5, as approximate for the stowage of separate-loading projectiles. Rocket warhead are to be stowed with shipping caps place.

Rocket warheads loaded with chemicals shall be stowed in dry, we ventilated enclosures on the upper decks, convenient for jettisoning in a emergency. These warheads should not be stowed with high-explosive warheads, unless otherwise authorized by the Bureau of Naval Weapons

The instructions for storing oth aircraft rockets apply also to the 2.75-inch and ZUNI folding-fin aircr rockets. Motors packed in combination launcher-containers, such as th Aero 6A and LAU-10/A (see chapte 7) and assembled 2.75-inch FFARs packed in the Aero 7D shipper-launcher-container (see chapter 7), may be stored in magazines ashore and afloat as received. Outside storage of these containers is limite to 180 days because of their paper and fiberboard construction. If, in a emergency, outside storage is all th is availabe over this period, the rocket motors in the containers are to be turned in to an ammunition dep for inspection, overhaul, and re-packing in new launcher-containers.

1-24.2 READY SERVICE. The limit tions on ready-service stowage of assembled rockets, because of the greater risk of missile damage and because of the risk of deterioration from exposure, apply to 2.75-inch FFARs also. Stowage of assembled rockets under these limited conditio in the four-round container, figure 1-20, is preferred to exposed stowag

Solid-and inert-loaded practice rocket components may be stowed in locations for convenience. These ar inert materials and shall not be stow

in magazines. However, they must be protected from moisture so that the threads and exterior surfaces will not rust.

1-24.3 MOTORS. Rocket motors are stowed in primary smokeless-powder-type magazines. Ready-service magazines, compartments, or lockers, as defined by OP 4 and OP 5, may be used for stowage of small numbers of assembled rockets. The propellant grains must not be exposed to abnormal temperatures. Prolonged stowage of rocket propellants, except for those used with 2.75-inch and ZUNI folding-fin aircraft rockets, at or above 100°F is hazardous. Since shipboard surveillance tests are not authorized, the oldest propellant lots shall be used first for maximum safety.

Motors which have been stowed in high temperatures should receive special attention, as follows:

90-100°F	No action necessary.
100-110°F	Employ artificial cooling as practicable.
110-120°F	1. Employ artificial cooling as practicable. 2. Segregate these motors and load them first for firing. 3. Make a special record of the number of hours in which the motors have been in temperatures above 110°F. When the cumulative total of hours above 110°F reaches 500, segregate these motors and turn them in to an ammunition depot at the first opportunity. 4. Record also the maximum stowage temperature reached in each hour of exposure to temperatures above 110°F.
120-130°F	1. Employ artificial cooling as practicable. 2. Segregate these motors and turn them in to an ammunition depot at the first opportunity. 3. A cumulative time record is to be maintained on all rockets stored at these temperatures.
Above 130°F	1. Turn in to an ammunition depot immediately. 2. If no depot is immediately available, consider these motors hazardous and dispose of them accordingly. 3. Maintain a cumulative time record for all rockets stored above 130°F.

Rocket motors for the 2.75-inch and ZUNI folding-fin aircraft rockets are relatively insensitive to temperature. The over-all firing temperature range for the ZUNI rocket is -30 to 165°F and for the 2.75-inch FFAR the range is -65 to 150°F. The over-all storage temperature range for the ZUNI rocket is 0 to 100°F. All ZUNI motors that have been in storage shall be temperature conditioned at a temperature between 0 to 120°F for a period of 24 hours before being loaded on an aircraft.

Stowage of unboxed rocket motors aboard a combatant ship, 20 percent with fin assemblies attached, is authorized. When stowing unboxed motors, figure 1-24, the following regulations apply:

1. Motors must be supported at two points. For 5.0-inch motors, the distance between supports should be 15 inches or greater, with the supports approximately equidistant from the

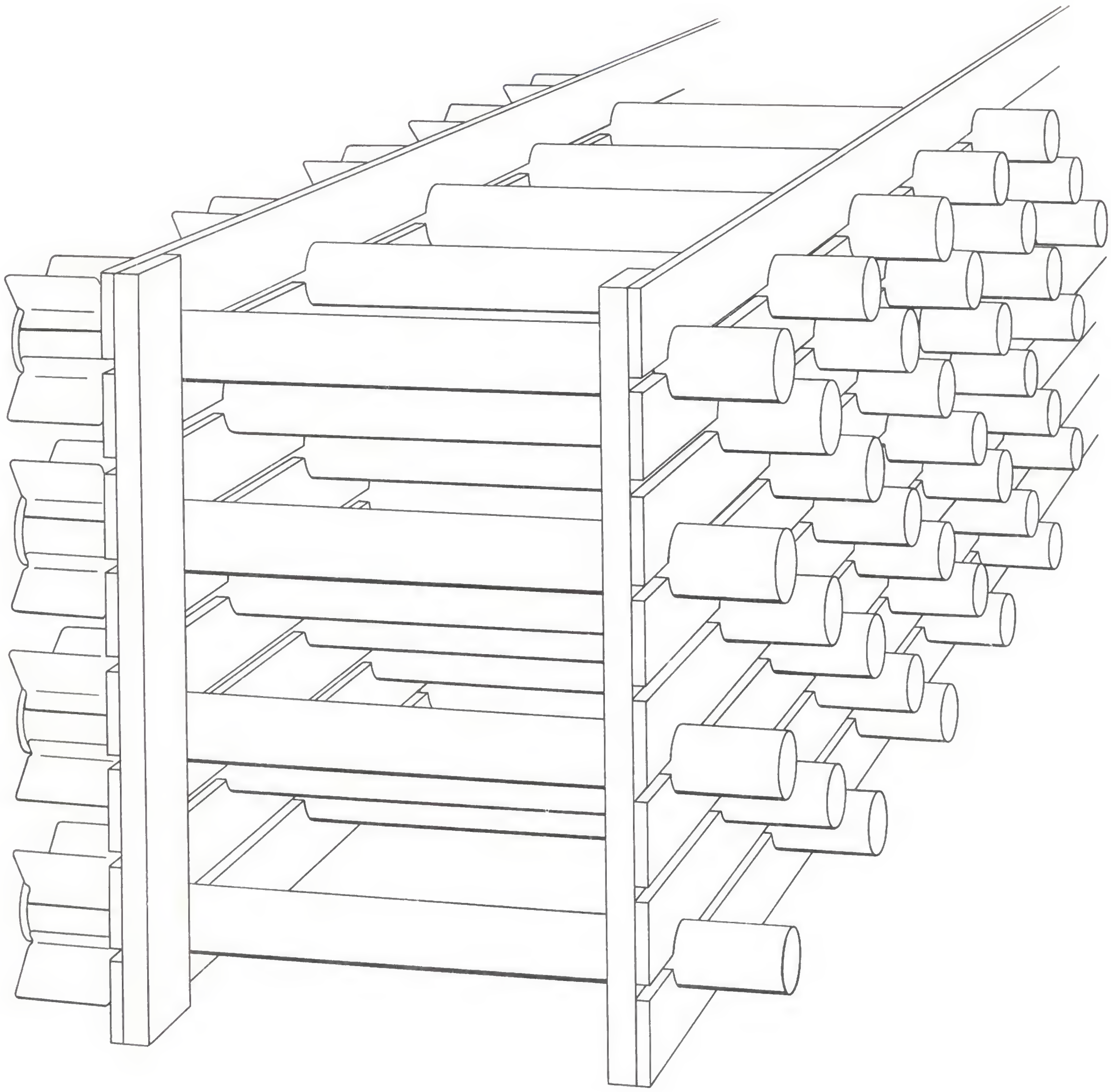


Figure 1-24. Typical Magazine Storage of Unboxed Rocket Motors.

center of the motor. There must be no interference with the suspension bands.

2. Motors must be secured against shifting or other motion.

3. Stacking in any manner whereby the motors rest upon each other is not permitted.

4. Motors must be stowed in a horizontal position.

5. Electrical components must be protected against breaks and short circuits.

6. External fittings and projections must be protected.

7. Metal parts must be protected against deformation. This will avoid damage to, or dislocation of, the propellant grain.

8. Motors shipped in the Aero 6A and LAU-10/A shipper-launcher-container packages, see chapter 7, and assembled 2.75-inch FFARs shipped in Aero 7D shipper-launcher-container packages, see chapter 7, may be stowed as received. The 2.75-inch

folding-fin aircraft rocket may be stored assembled (see paragraph 1-16).

1-24.4 FUZES. Separately issued nose fuzes which contain detonators or other explosive components shall be stowed only in designated fuze magazines. These fuze magazines shall not be located adjacent to magazines containing high explosives.

Nose fuzes are to be removed from their wooden outer container and stowed in their individual inner containers. Base fuzes are shipped permanently installed in their rocket warheads.

1-24.5 FIN ASSEMBLIES. These and other inert components may be stowed in any suitable space other than ammunition magazines. Stowage of uncrated fin assemblies in the vicinity of the rocket assembly area is authorized, provided the fin assemblies are rigidly secured.

1-24.6 STOWAGE PRECAUTIONS. The following stowage precautions shall be observed:

1. Stow rocket motors separately from rocket warheads where possible.

2. Rocket warheads for which fuzes are issued separately shall not be stowed with those fuzes installed in or near magazines containing explosives. If rocket warheads, for which fuzes are issued separately, are returned to the magazine with fuzes installed, remove fuzes or, as for the 2.75-inch FFAR, stow the assembled rocket warhead apart from other ammunition.

3. Electrically fired rocket motors and electric or electronic fuzes shall not be stowed in the same compartment with, or be exposed within 5 feet of, any exposed electronic transmitting apparatus or exposed antenna leads. (Check NAVWEPS 16-1-529.)

4. Matches, naked lights, flame producing devices, or any open flame is forbidden in the vicinity of rocket stowage.

5. Rockets containing pyrotechnic material, such as flares or an incendiary mixture, shall be stowed in regular pyrotechnic stowage spaces, if such are provided, or in pyrotechnic lockers on upper decks.

6. Nothing shall be stowed in rocket ammunition magazines except rocket ammunition, containers, and authorized magazine equipment. No oily rags, waste, or material susceptible to spontaneous combustion shall be stowed in these spaces.

7. Remove all rocket explosive components from a magazine before work which might cause an abnormally high temperature or an intense local heat is undertaken in the magazine.

8. Ready-service stowage of assembled rockets is authorized only for the 2.75-inch and 5.0-inch (ZUNI) folding-fin aircraft rockets. When the 2.75-inch rocket is shipped in the Aero 7D shipper-launcher-container, it may be stored as received, completely assembled. When partially ready rockets are required, in addition to ready-service stowage, unboxed rocket motors with fin assemblies attached should be stowed in below-deck magazines adjacent to bomb elevators. This stowage is authorized for rockets of the fixed-fin configuration instead of ready-service stowage. A separate locker may be provided for stowage of ready-service nose fuzes since these fuzes are not installed in warheads until the rockets are assembled and loaded on the launcher. This does not apply to the 2.75-inch FFAR; this warhead is stowed with the fuze installed.

9. Rockets should be kept in the shade, away from direct sunlight, to avoid raising their propellant

temperature above the prescribed safe limit.

1-25 MAINTENANCE AND DISPOSAL

The inspections and reports required on rockets in stowage are specified in OP 4 and OP 5 and other administrative directives.

Repairs which are specifically permitted may be made by the ship or station using the ammunition. All other repairs may be made only by an ammunition depot. Components requiring these repairs must be turned in to a depot at the earliest opportunity.

Components in a hazardous condition should be disposed of by explosive ordnance disposal personnel. If such personnel is not available, the disposal will be performed as instructed by the officer in charge. Normally, this will mean lowering the item gently over the side in water at least 500 fathoms deep, 10 miles or more from shore.

Reports of any difficulties encountered with rocket components should be sent to the Bureau of Naval Weapons. The report should contain the lot number and history of the components involved. These reports will assist in the institution of measures to prevent recurrence of the difficulty.

1-25.1 REPAIRS PERMITTED ABOARD SHIP. For rocket heads, only the repainting, relettering, and removal of rust and corrosion are authorized.

For motors, only the repainting, relettering, removal of rust and corrosion, and repair of inert items are authorized. Fins, if dented or bent slightly, may be straightened with pliers, providing such action permits easy restoration of the original alignment. Check the straightened fin with a straight edge.

For fuzes, no shipboard repair or alteration is authorized.

1-25.2 INSPECTIONS. Inspection of components will be made as they are removed from containers for assembly or prior to their being placed in containers for return to stowage. Items found in a hazardous condition should be disposed of by explosive ordnance disposal personnel or if none are available, as instructed by the officer in charge of the operation.

1-25.3 TURNING IN COMPONENTS FOR REWORK. At least 5 percent of the service allowance of rocket warheads assembled with base fuzes shall be turned in to the depot at the time of a general ammunition overhaul. The depot will examine the warheads for serviceability for continued stowage aboard ship.

The service allowance of rocket warheads shall be inspected by the commanding officer of the ammunition depot in company with the gunnery officer of the ship, or their representatives, prior to or during the period of the ammunition overhaul to determine what overhaul is required. If considered necessary, such warheads shall be turned in to the depot without further reference to the Bureau of Naval Weapons. Rocket warheads stowed aboard ship without base fuzes need not be turned in to the depot unless such action seems necessary after the inspection.

Shore-based, rocket-using activities will report overage rocket motors on hand to the Bureau of Naval Weapons and request shipping instructions for their disposition. When turning in rocket motors which have been stored in temperatures above 100°F, the special records required for stowage in high temperatures should be turned in to the depot with the motors. (Refer to paragraph 1-24.)

When rocket warheads are being turned in, the nose fuzes issued for assembly in these warheads also should be turned in for inspection by the depot.

Items such as fins, tanks, and packing boxes shall be given a visual examination to determine their serviceability. Empty tanks and boxes, and all unserviceable fins shall be turned in to the depot. Replacement fins will be supplied when ammunition is reissued to the ship.

1-26 MARKING AND IDENTIFICATION

1-26.1 GENERAL. Rocket assemblies and components are painted, stamped, or tagged in accordance with Ordnance Specifications. Because of the different nature of rocket components, their identification systems are different. The methods of identification and the components to which they apply are described in the following paragraphs.

1-26.2 NOMENCLATURE. Where special rules do not apply, a rocket component is classified by its generic term, followed by its mark and mod designation; for example, Igniter Mk 120 Mod 2. For heads, motors, and complete rounds, there are special rules. The nomenclature consists of information combined in the following sequence:

1. Heads

a. Caliber

b. The words "Rocket Head"

c. Mark and mod of the inert parts, considered as a unit

d. Parenthetical descriptive term describing the load in the head, such as (GP), (VT), or (PRAC)

A typical example is a 5.0-Inch Rocket Warhead Mk 6 Mod 4 (VT). The mark and mod designation of the head does not change with a change in the load of the head; only the parenthetical term changes.

2. Motors

a. Caliber

b. The words "Rocket Motor"

c. Mark and mod of the loaded motor

A typical example is 5.0-Inch Rocket Motor Mk 10 Mod 6. The mark and mod of the loaded motor may not necessarily be the same mark and mod as the inert parts. In the first motor of a series, this mark and mod usually will be the same, but if the igniter, propellant grain, electrical connector, or some other component is changed, a new mark or mod designation will be assigned.

3. Complete rounds

a. Caliber (of the head if there is a difference in caliber between the head and the motor)

b. The word "Rocket"

c. Mark and mod of the complete assembly

d. Parenthetical phrase including the type of head, such as (AP) or (SC), followed by AR for aircraft rockets

Rockets used in antisubmarine warfare are designated as ASW.

Typical examples are 2.25-Inch Rocket Mk 4 Mod 0 (SCAR) and 5.0-Inch Rocket Mk 34 Mod 0 (AP/ASW, HVAR).

1-26.3 MARK AND MOD. These designations are assigned rocket components on the same basis as those for other Navy ordnance. The practice for heads and motors has already been discussed. For complete rocket assemblies, the following rules apply:

1. The mark number changes when the new design falls into one of the following categories:

a. It is dimensionally different or noninterchangeable to the extent that it cannot be fired from the same launcher.

b. It is different in its exterior ballistics.

c. It has a different load in its head; for example, the head load is changed from general purpose (GP) to practice (PRAC).

2. The mod number changes when one of the following takes place:

a. The fuze(s) is changed.

b. The dimensions are not changed enough to require a different launcher, but enough to require different stowage or handling equipment.

c. The chemical nature of the head filling is changed (not the type of filling but its actual substance); for example, the smoke mixture in a head is changed from FS to PWP.

1-26.4 DRAWING NUMBERS. Components which are not of enough importance or which are not separate in their nature are not assigned mark and mod numbers. They are designated by their drawing number.

1-26.5 COLOR CODING. Rocket heads motors, and accessories are painted different colors to distinguish types. Fuzes are not painted, while fin assemblies are painted the same color as the motor.

The coding used for motors is shown in figure 1-25. Color coding for warheads is shown in figure 1-26. The color code representative for launchers is shown in figure 1-27.

1-26.6 LOT NUMBERS. The ammunition lot system provides a means

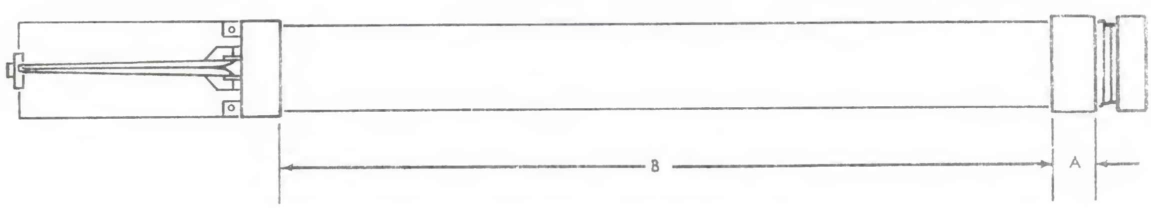


Figure 1-25. Motor Color Coding.

Item	Location "A" color	Location "B" color	Remarks
Rocket Motors (loaded)[1]	Brown band to indicate contents[2]	Olive drab or white	Threaded surfaces are not painted.
Rocket Motors (inert)[1]	Blue	Blue	Threaded surfaces are not painted.

[1] Rocket motors include only those motors assembled with warheads which contain no guidance system. Motors assembled with warheads containing a guidance system fall into the missile category and are not covered by this OP.

[2] Width of band is to be one half the diameter of the motor.

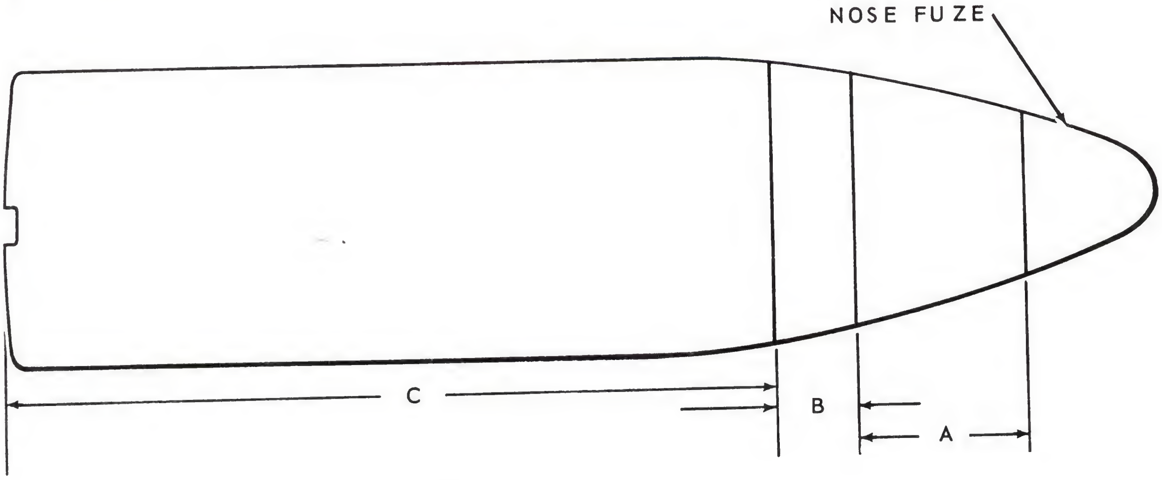


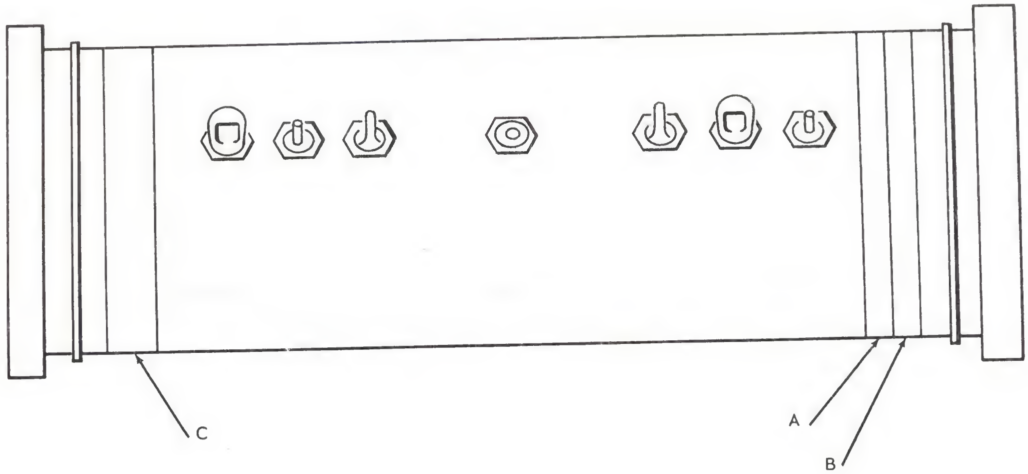
Figure 1-26. Warhead Color Coding.

Item	Location "A" color	Location "B" color	Location "C" color	Remarks
Armor Piercing (AP) Warhead	Black band to indicate primary use[1] (high explosive antitank is considered armor piercing therefore primary band is black)	Yellow[2]	Olive drab	No paint on nose fuze or threaded surfaces.
High Explosive (HE) Warhead	Yellow band to indicate primary use[1]	Olive drab	Olive drab	No paint on nose fuze or threaded surfaces (dummy nose fuze-painted yellow)
Illuminating Warhead	White band to indicate primary use[1]	Brown[2]	Olive drab	No paint on nose fuze or threaded surfaces
Smoke Warhead	Light green band to indicate primary use[1,3]	Brown[2]	Olive drab	No paint on nose fuze or threaded surfaces.
Practice Warhead	Blue	Blue	Blue	Dummy nose fuze, blue.

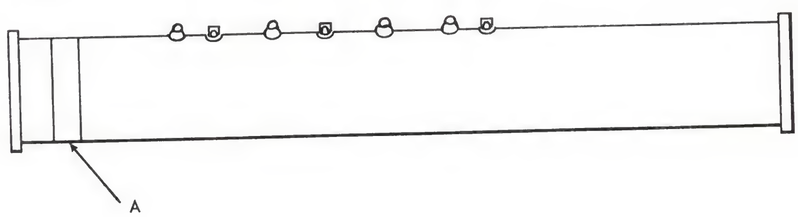
[1]Width of band is to be one half the diameter of the warhead; not to exceed 3 inches.

[2]Width of band is to be one fourth of the diameter of the warhead; not to exceed 1-1/2 inches.

[3]The symbol of the smoke filler should be placed in red letters not less than 3/4-inch high on the light green band. Examples of marking of contents would be "PWP" for plasticized white phosphorus and "WP" for white phosphorus.



REPRESENTATIVE LAUNCHER CONTAINING READY TO FIRE ROUNDS



REPRESENTATIVE LAUNCHER CONTAINING ROCKET MOTORS ONLY

Figure 1-27. Representative Launcher Color Coding.

Item	Location "A" color	Location "B" color	Location "C" color
Launcher containing ready-to-fire rounds	Black band 1 1/2 inches wide if launcher is loaded with HEAT warheads. Yellow band 1 1/2 inches wide if launcher is loaded with HE warheads. Blue band 1 1/2 inches wide if launcher is loaded with practice warheads.[1]	Yellow band 1 1/2 inches wide if warheads contain high explosive. Blue band 1 1/2 inches wide if warheads are inert loaded.	Brown band 3 inches wide if motors are loaded with propellant. Blue band 3 inches wide if motors are inert.[1]
Launcher containing rocket motors only	Brown band 3 inches wide if motors are loaded with propellant. Blue band 3 inches wide if motors are inert.[2]		

[1] Bands are placed 2 inches from forward end pan.
[2] Bands are placed 2 inches from aft end pan.

by which records may be maintained of the components assembled. The ammunition lot serves as a unit by which defective components may be restricted from issue or from service use. The lot number also is a unit for stowage and shipping.

Each ammunition lot is assigned a number consisting of three parts-the prefix designation, the numerical group, and the suffix. A typical lot number is RHDF-1764-HAW-45.

The first letter "R" of the prefix designation indicates rocket ammunition. The second letter indicates the rocket unit. In this example, "H" indicates head. "M" would indicate motor, and "T" would indicate a head and a motor packed unassembled in a single container. The third letter (A to Z) and the fourth letter (A to Z) are assigned from a list of rocket assemblies to designate the caliber and type of load, respectively. Examples are:

1. RHDF—7.2-inch HE rocket warhead with HBX-1 explosive filler.

2. RTCD—2.75-inch HEAT rocket with an RHHC rocket warhead (composition B filler) and an RMHA rocket motor.

The numerical group is one of a consecutive series of numbers assigned under each prefix designation by a particular ammunition loading activity. Each numerical group begins with number one (1) for the first lot loaded under each prefix designation in the year of 1945 and continues consecutively ad infinitum.

The suffix consists of a code group assigned to identify each loading activity and the year of assembly. In the example, "HAW" represents Naval Ammunition Depot, Hawthorne, Nevada.

A complete reading of the legend "RHDF-1764-HAW-45" is "the 1764th lot of 7.2-inch rocket warhead (HE) loaded with HBX-1 explosive filler at Hawthorne. This lot was assembled in 1945."

1-26.7 MARKING. Rocket heads, motors, and fuzes are identified by legends which may be stenciled, rubber stamped, or indent stamped on their exterior. Rocket heads have four legends, motors have three, and fuzes one. Following are descriptions of each of the legends.

1-26.7.1 Manufacturer's Identifying Legend. This is indent stamped by the metal parts manufacturer on each head and motor. It contains the following information:

a. The first line contains the nominal caliber in inches; the word "HEAD" or "MOTOR," as applicable; and the applicable mark and mod number.

b. The second line bears the Bureau of Naval Weapons drawing number.

c. The third line contains the contract number and the contractor's lot number.

d. The fourth line bears the contractor's initials or identifying symbol, and the Department of Defense inspector's stamp (eagle) or Navy inspector's stamp (anchor) indicating acceptance of an item.

1-26.7.2 Manufacturer's Code Symbol. This is indent stamped by the inert metal parts manufacturer on each head and motor. It contains the following information:

a. Applicable mark and mod numbers.

b. The code number designating the type of inert parts assembly as follows:

ASSEMBLY	CODE NUMBER
Rocket head	3
Rocket motor	4

c. The letter symbol assigned by the Bureau of Naval Weapons to each manufacturer which applies to all inert parts assemblies of any one type.

d. The same lot number used in the manufacturer's identifying legend.

A typical manufacturer's code symbol might be Mk 17-2 Lot 4A157. This would mean Lot No. 157 of Rocket Motor Mk 17 Mod 2 manufactured by a contractor identified by the letter A.

1-26.7.3 Head Legend (First). The following legend is placed by the loading activity on the head only. It is located 120 degrees from the manufacturer's identifying legend.

a. The type of filler, such as WP-SMOKE or CAST TNT; and the weight of the filler to the nearest tenth of a pound

b. Navy ammunition lot number

c. Navy ammunition code numbe

d. Mark and mod number of the base detonating fuze. This is omitted when no such fuze is installed.

1-26.7.4 Head Legend (Second). The following legend also is placed by the loading activity on the head only. It i located 240 degrees from the manufacturer's identifying legend. It consists of one of the following to indica the type of load: HE, GP, SOLID, FLARE, INERT, or SM.

1-26.7.5 Motor Legend. The followi legend is placed only on the motor by the loading activity. It is located 180 degrees from the manufacturer's identifying legend on the motor.

a. Propellant grain mark and mod number; and propellant grain lot number, which indicates the grain extrusion activity followed by the lot number. For example, "NPF 21" means Lot No. 21 from the Naval Powder Factory.

b. Navy ammunition lot number

c. Navy motor code number

d. Motor temperature limits

1-26.7.6 Fuze Legend. The following legend is usually indent stamped on the fuze. The arrangement of its data may vary to conform to the shap of the fuze. The legend will contain the following information:

a. Letters indicating the type of fuze, such as "NF," or "BDF"

b. The mark and mod

c. The manufacturer's initials or symbol

d. The lot number

e. The initials or symbol of the loading activity.

f. The month and year of loading

g. Department of Defense inspector's stamp (eagle) or Navy inspector's stamp (anchor)

1-26.7.7 Propellant Grain Legend. This is rubber stamped or indent stamped, and includes the manufacturer's initials, lot number, and mark and mod.

1-26.7.8 Igniter Legend. Either stamped or stenciled, this legend includes the term "igniter," mark and mod, lot number, loading depot symbol, and date of loading (month and year).

1-26.7.9 Auxiliary Booster Legend. This is either rubber stamped on the booster or printed on a label attached to the booster. The legend consists of the term "auxiliary booster," mark and mod, weight (in grams), the explosive filler, lot number, place of loading, date of loading (month and year), and the inspector's initials.

1-26.7.10 Electric Connector Legend. This is stamped on a cable clamp or a cable marking tape. The legend consists of the mark and mod only.

1-26.8 DATA CARDS. Data cards are made for each ammunition lot of rockets and components, listing such information as caliber, quantity, contract number, container dimension, contents, components, mark and mod, nose fuze thread diameter, note as to use with other components of round, propellant grain loading, and reference to pertinent Ordnance Pamphlets. This information is necessary in making out defective ammunition reports. One copy of the data card is included in each shipping container.

1-27 GENERAL SAFETY PRECAUTIONS

The general precautions follow. Specific regulations are found in other portions of this publication where they apply.

1. The Bureau of Naval Weapons shall be informed of any circumstances which conflict with the safety precautions or which, for any reason, require changes in or additons to them.

2. When in doubt as to the exact meaning of a safety precaution, an interpretation shall be requested from the Bureau of Naval Weapons.

3. Do not make changes in or additions to rocket material without explicit authority from the Bureau of Naval Weapons.

4. No ammunition or explosive assembly shall be used in any rocket launcher for which it is not designated.

5. No ammunition other than dummy-drill shall be used for drill.

1-28 REFERENCE DOCUMENTS

1. Bureau of Naval Weapons. Ammunition Ashore, Handling, Stowing, and Shipping. Washington, D. C., (OP 5, Volume 1, Second Revision), 9 August 1957.

2. Bureau of Naval Weapons. Ammunition Afloat. Washington, D. C., (OP 4, Volumes 1 and 2, Second Revision) 12 August 1958.

3. Bureau of Naval Weapons. Radio-Frequency Hazards Manual (U), Washington, D. C. (NAVWEPS 16-1-529), 1 July 1964 (CONFIDENTIAL).

Chapter 2
ROCKET WARHEADS

2-1 2.75-INCH ROCKET WARHEAD MK 1 MODS 1, 3, 4, AND 5

The 2.75-Inch Rocket Warhead Mk 1 Mod 5 is shown in figure 2-1.

The differences in the mods of this head are as follows:

1. Mod 1 is of one-piece, forged construction without a fuze cavity liner.

2. Mod 3 is cold-formed without a fuze cavity liner.

3. Mod 4 is made of two pieces brazed together (near the bourrelet) with cavity liner.

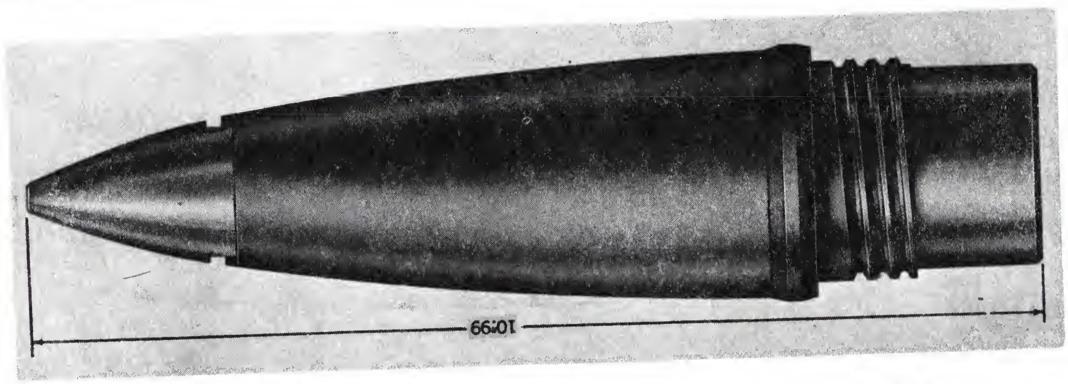


Figure 2-1. 2.75-Inch Rocket Warhead Mk 1 Mod 5 (HE or PRAC), External View.

Mark	1	1	1	1
Mod	1	3	4	5
Lot No. Prefix:				
HE	RHHA	RHHA	RHHA	RHHA
PRAC	RHHB	RHHB	RHHB	RHHB
List of Drawings	174702	174806	255945	255946
Loading Assembly No.	656227	656227	656227	656227
Overall Shipping Length (in.)	10.99	10.99	10.99	10.99
Nominal Weight (lb)	6.47	6.47	6.47	6.47
Filler:				
Type:				
HE	HBX-1	HBX-1	HBX-1	HBX-1
PRAC	Inert	Inert	Inert	Inert
Weight (lb)	1.40	1.40	1.40	1.40

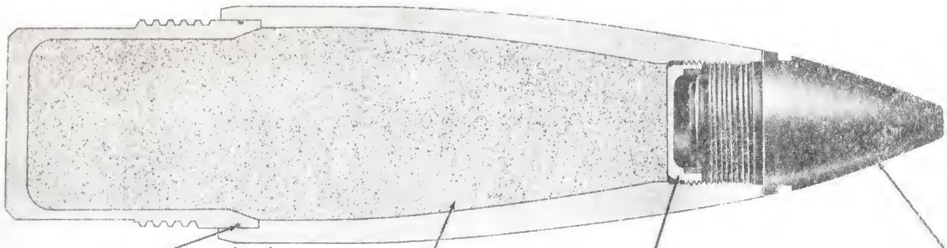


Figure 2-2. 2.75-Inch Rocket Warhead Mk 1 Mod 5 (HE), Sectional View.

4. Mod 5 is similar to the Mod 4, except that the base is formed by stamping instead of forging.

Any of these mods may be loaded with an inert filler instead of HBX-1 (Comp B after 1 January 1966) to become a practice head. A steel nose plug is assembled in practice heads in place of the nose fuze. Inert loaded heads do not require fuze cavity liners, although some do have them.

A sectional view of the 2.75-Inch Rocket Warhead Mk 1 Mod 5 (HE) is shown in figure 2-2.

2-2 2.75-INCH ROCKET WARHEAD MK 5 MOD 0 (HEAT)

The 2.75-Inch Warhead Mk 5 Mod 0 (HEAT) is shown in figure 2-3.

Mark	5
Mod	0
Lot No. Prefix	RHHC
List of Drawings	256096
Loading Assembly No.	1350663
Overall Shipping Length (in.)	11.08
Nominal Weight (lb)	6.60
Filler:	
Type	Comp B
Weight (lb)	0.89
Booster:	
Type	Tetryl
Weight (gm)	13.8
Container Mk-Mod	12-0

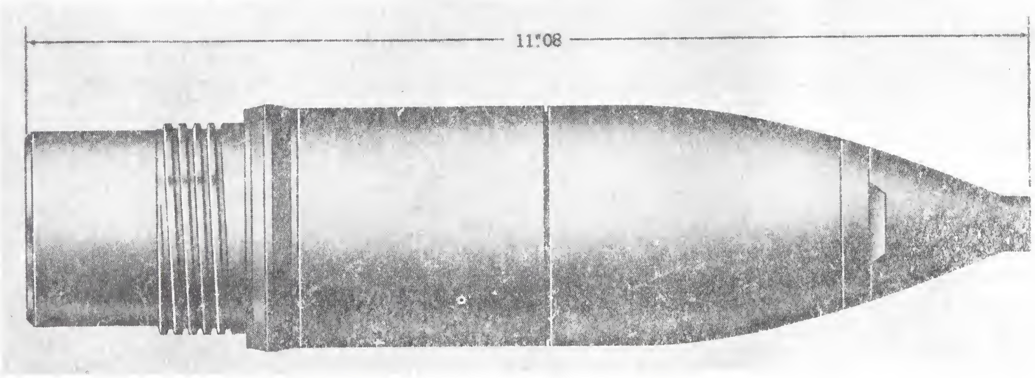


Figure 2-3. 2.75-Inch Rocket Warhead Mk 5 Mod 0 (HEAT), External View.

Unlike the earlier shaped-charge warhead for aircraft rockets, this warhead employs no detonating cord to transmit the explosive impulse of the nose fuze to the main filler. The shaped-charge booster in the nose fuze propels an explosive jet through the cone and flash tube unassisted to the booster pellet, which then detonates the main filler. There are relatively few fragments of the warhead scattered in the explosion; these are in a narrow cone of dispersion.

2-3 5.0-INCH ROCKET WARHEAD MK 2 MOD 2 (AP)

The 5.0-Inch Rocket Warhead Mk 2 Mod 2 (AP) is illustrated in figure 2-4. A cross section of this warhead is shown in figure 2-5.

Mark	2
Mod	2
Lot No. Prefix	RHCQ
List of Drawings	165464
Loading Assembly No.	562638
Overall Shipping Length (in.)	14.73
Length Without Details (in.)	13.63
Nominal Weight Shipped (lb)	51.98
Nominal Weight Fired (lb)	48.30
Filler:	
Type	Explosive D
Weight (lb)	2.2
Base Fuze Mk-Mod	166-0 or 2
Container Mk-Mod	22-0

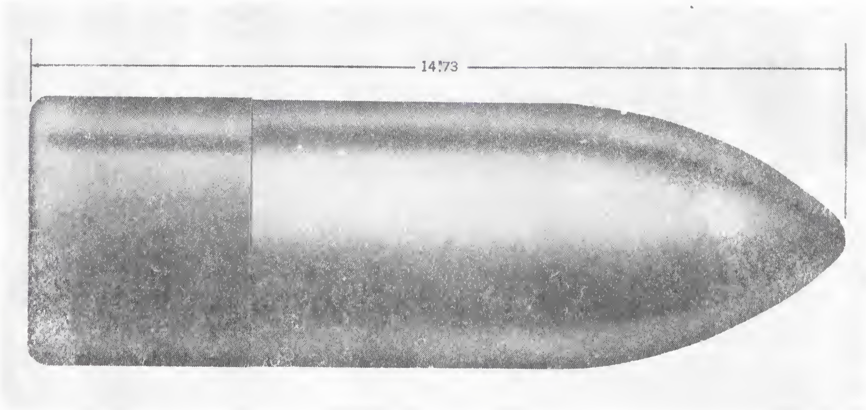


Figure 2-4. 5.0-Inch Rocket Warhead Mk 2 Mod 2 (AP), External View.

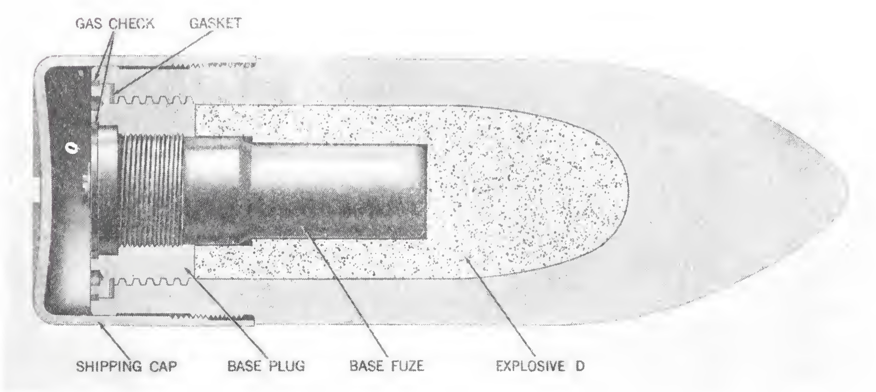


Figure 2-5. 5.0-Inch Rocket Warhead Mk 2 Mod 2 (AP), Cross Section.

2-4 5.0-INCH ROCKET WARHEAD MK 4 MOD 1 (SMOKE-PWP)

The 5.0-Inch Rocket Warhead Mk 4 Mod 1 (SMOKE-PWP) is shown in figure 2-6.

This smoke warhead is designed for pinpointing surface targets or for filling gaps in smoke screens.

Mark	4
Mod	1
Lot No. Prefix	RHCG
List of Drawings	174830
Loading Assembly No.	656341
Overall Shipping Length (in.)	34.60
Length Without Details (in.)	33.28
Nominal Weight Shipped (lb)	52.00
Nominal Weight Fired (lb) (Without Nose Fuze)	48.09
Filler:	
Type	PWP
Weight (lb)	19.36
Burster Charge:	
Type	Tetryl
Weight (gm) (approx)	135
Container Mk-Mod	15-1

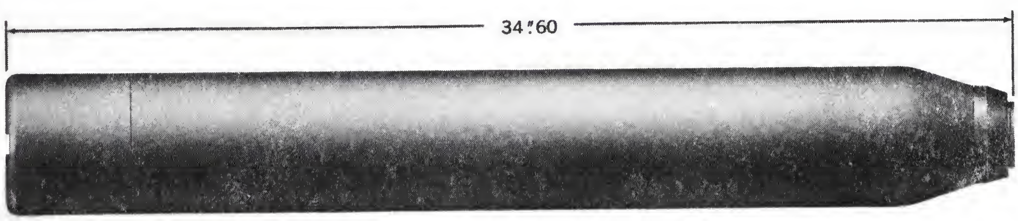


Figure 2-6. 5.0-Inch Rocket Warhead Mk 4 Mod 1 (SMOKE-PWP), External View.

2-5 5.0-INCH ROCKET WARHEAD MK 6 MOD 1 (HE) AND MOD 4 (VT)

The 5.0-Inch Rocket Warhead Mk 6 Mod 4 (VT) is illustrated in figure 2-7.

Cross sectional views of the Mk 6 Mod 4 (VT) and Mk 6 Mod 1 (HE) are shown in figure 2-8.

The principal difference between the mods of this warhead is the special cavity of the Mod 4 which is designed to receive a VT fuze.

When the Mod 1 is fuzed with Nose Fuze Mk 149, theoretically this head should make a 5-inch hole in 1 1/2-inch-thick armor. Against armor of this thickness, there will be only a small number of fragments behind the plate. With the nose fuze made inoperative, so that detonation will be initiated by the short-delay base fuze, this warhead should penetrate 1-inch armor and explode with maximum effectiveness a few feet behind the plate.

Against reinforced concrete (5000 psi), this warhead is capable of penetrating 3.75-inch slabs at normal obliquity and 2.75-inch slabs at 30-degree obliquity. The nose fuze should be set on SAFE against concrete, so that detonation will be initiated by the short-delay base fuze.

Figure 2-7. 5.0-Inch Rocket Warhead Mk 6 Mod 4 (VT), External View.

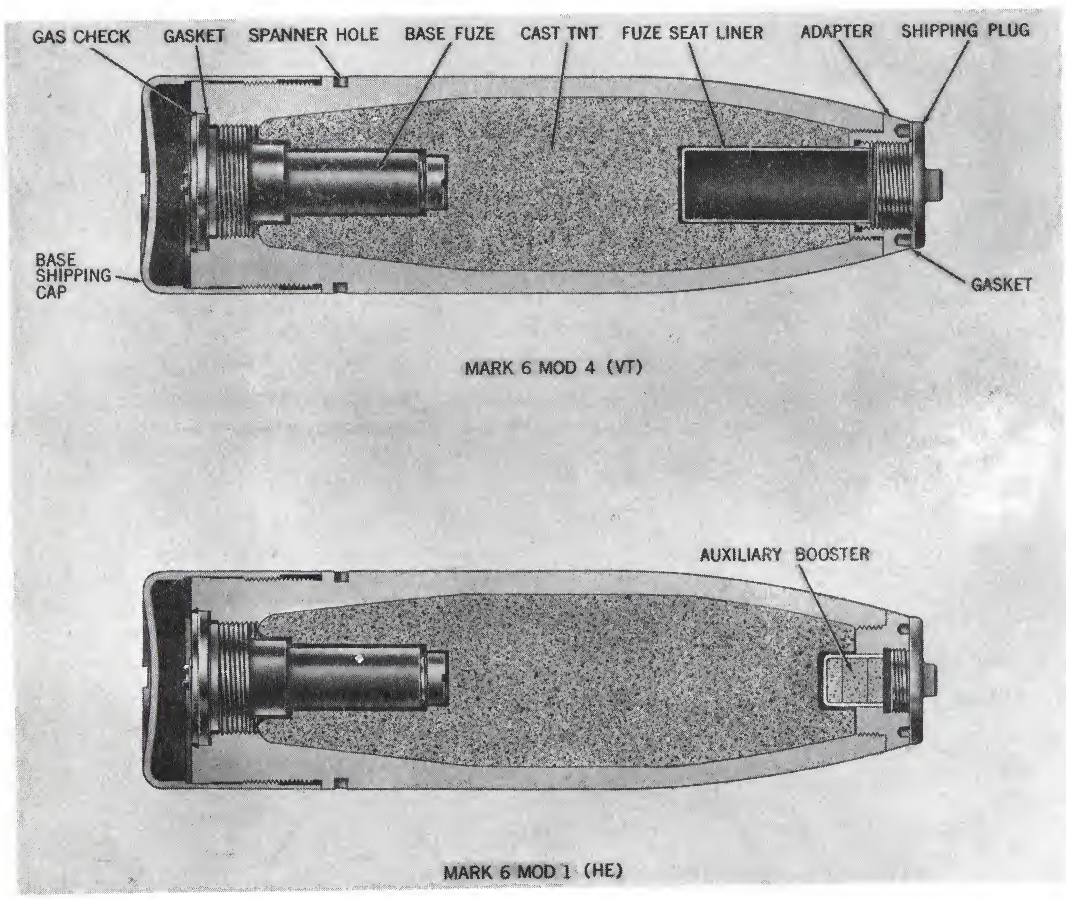


Figure 2-8. 5.0-Inch Rocket Warheads Mk 6 Mod 4 (VT) and Mk 6 Mod 1 (HE), Cross Sections.

Warhead Type	HE	VT
Mark	6	6
Mod	1	4
Lot No. Prefix	RHCJ	RHCY
List of Drawings	165018	174569
Loading Assembly No.	561527	655874
Overall Shipping Length (in.)	18.30	18.43
Length Without Details (in.)	16.45	16.45
Nominal Weight Shipped (lb)	50.55	49.89
Nominal Weight Fired (lb) (Without Nose Fuze)	45.87	45.04
Filler		
Type	TNT	TNT
Weight (lb)	7.60	7.10
Booster:		
Mk-Mod	3-1	None
Number Required	1	None
Nose Fuze Mk-Mod	149-0 or 1	172-2 (VT)
Base Fuze Mk-Mod	164-0	164-0
Container Mk-Mod	12-0	12-0
Pallet Adapter Mk-Mod	11-1	11-1
Pallet Unit Load	1341931	1341931
Lot No. Prefix (Practice Head)	RHCI	RHCI

2-6 5.0-INCH ROCKET WARHEAD MK 24 MOD 0 (HE)

The 5.0-Inch Rocket Warhead Mk 24 Mod 0 (HE) is shown in figure 2-9.

This warhead was designed primarily for use with the 5.0-inch FFAR (ZUNI) and fulfills a variety of tactical needs. The warhead produces fragments and may be fuzed for contact, influence, or delayed detonation. Built into the warhead is a base fuze that is used in conjunction with a steel ogive nose plug. The steel ogive enables the head to penetrate heavy targets, such as concrete buildings or surface vessels, and to detonate inside. Nose fuzes, Mk 188 (PD) or the M414 (VT), may be used with this warhead.

Figure 2-9. 5.0-Inch Rocket Warhead Mk 24 Mod 0, External View.

Warhead Type	PD	VT
Mark	24	24
Mod	0	0
Lot No. Prefix	RHZA	RHZB
List of Drawings	174919	174919
Loading Assembly No.	656560	656560
Overall Shipping Length (in.) (approx)	19.107	19.107
Length Without Details (in.)	17.850	17.850
Filler:		
Type	Comp B	Comp B
Weight (lb)	9.10	9.10
Nose Fuze Mk-Mod	188-0	M414
Nose Ogive	458162	458162
Base Fuze Mk-Mod	191-1	191-1
Container Mk-Mod	39-0	39-0

2-7 5.0-INCH ROCKET WARHEAD MK 25 MODS 1 AND 2 (HEAT)

The 5.0-Inch Rocket Warhead Mk 25 Mod 2 (HEAT) is shown in figure 2-10.

The Mod 2 differs from the Mod 1 principally in the construction of the adapter. The Mod 1 adapter is brazed directly onto the nose assembly. The Mod 2 adapter is threaded to a ring, which is brazed onto the nose assembly.

During proving ground tests, the 5.0-Inch Rocket Warhead Mk 25 gave three times as many fragmen perforations of 1/8-inch mild steel and two times as many perforation of 3/8-inch mild steel at 30 feet, a compared to general purpose Warh Mk 6. Also, the blast effect of this warhead is appreciably greate than that of the GP warhead.

This warhead was developed primarily for use against tanks.

Because of the thin wall and relatively large explosive charge, fragments from the warhead are projec at extremely high velocities. Altho

Mark	25	25
Mod	1	2
Lot No. Prefix	RHCZ	RHCZ
List of Drawings	255540	268469
Loading Assembly No.	563481	656784
Overall Shipping Length (in.)	30.66	30.66
Length Without Details (in.)	29.16	29.16
Nominal Weight Shipped (lb)	51.65	51.65
Nominal Weight Fired (lb) (Without Nose Fuze)	47.85	47.85
Filler:		
Type	Comp B	Comp B
Weight (lb)	15.33	15.33
Initiator:		
Type	Tetryl	Tetryl
Weight (gm) (approx)	1.71	1.71
Booster:		
Type	Tetryl	Tetryl
Weight (gm) (approx)	126	126
Nose Fuze Mk-Mod	149-0 or 1	149-0 or 1
Container Mk-Mod	27-0	27-0
Pallet Adapter Mk-Mod	11-1	11-1
Pallet Unit Load	1341931	1341931

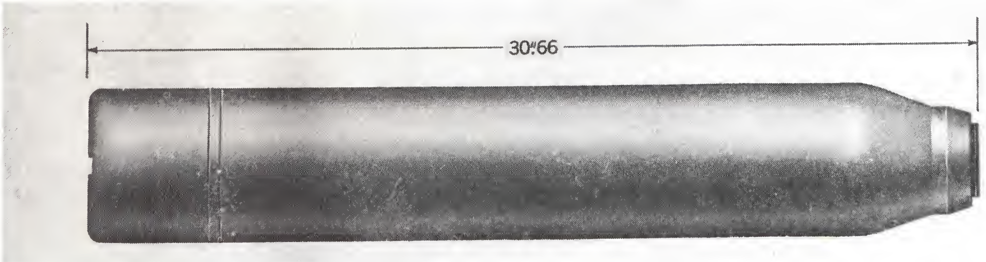


Figure 2-10. 5.0-Inch Rocket Warhead Mk 25 Mod 2 (HEAT), External View.

the fragments are somewhat smaller than those from a GP warhead, they are much more numerous.

However, it should be remembered that, with the shaped-charge warhead, detonation always occurs outside of the target. Any damage behind a heavy target will be as a result of the narrow, high-velocity, high-temperature jet from the shaped charge.

This warhead is assembled in the same manner as most of the other 5.0-inch warheads. In fuzing the warhead, no attempt should be made to remove the initiator case lock ring at the bottom of the fuze cavity. Care should also be taken to avoid striking the aluminum cap under the lock ring, since the initiator is beneath this cap.

2-8 5.0-INCH ROCKET WARHEAD MK 29 MOD 0 (AP/ASW)

This armor-piercing warhead, figure 2-11, is designed for use against submarines and other underwater targets.

Because Base Fuze Mk 166 caused the round to detonate outside the target, this fuze has been replaced by a base fuze hole plug. The plugged configuration of the Mk 29 warhead assures penetration, although the round will not detonate; this penetration, however, is sufficient to "kill" a submarine. The plugged Mk 29 contains an explosive charge; it is not an inert head and SHALL NOT be used for drill purposes or practice firing.

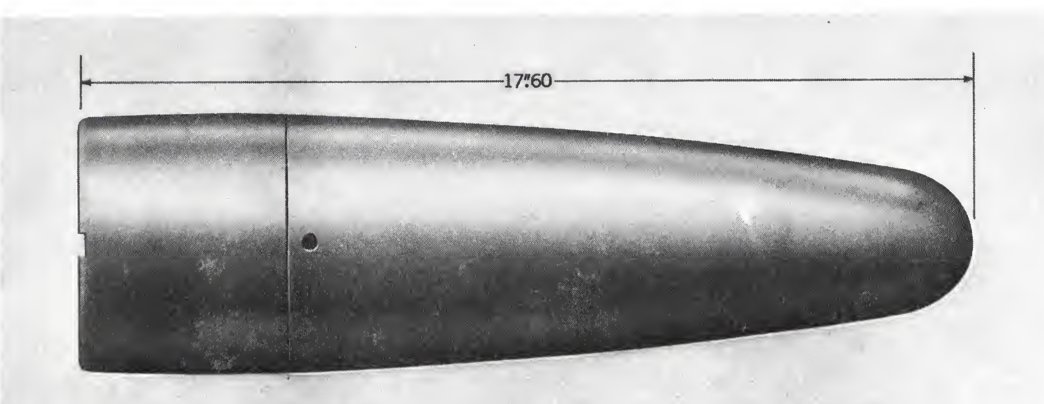


Figure 2-11. 5.0-Inch Rocket Warhead Mk 29 Mod 0 (AP/ASW), External View.

Mark	29
Mod	0
Lot No. Prefix	RHKA
List of Drawings	174796
Loading Assembly No.	656404
Overall Shipping Length (in.)	17.60
Length Without Details (in.)	16.50
Nominal Weight Shipped (lb)	52.24
Nominal Weight Fired (lb)	48.56
Filler:	
Type	Explosive D
Weight (lb)	3.03
Base Fuze Mk-Mod	Plugged
Container Mk-Mod	32-0

2-9 5.0-INCH ROCKET WARHEAD MK 32 MOD 0 (ATAP)

The Rocket Warhead Mk 32 Mod 0, figure 2-12, was designed primarily for use with the 5.0-inch FFAR (ZUN but is equally effective against heavy ground or surface targets. For shaped-charge action against heavily armored targets, the warhead is fitted with a point-detonating nose fu A 1/8-inch-thick copper cone inside the warhead produces the shaped jet Using an influence-detonating nose fuze for fragmentation action agains aircraft, the Warhead Mk 32 produce a destructive envelope of high-speec fragments. Fragmentation is controlled by a waffled plastic liner nex to the steel warhead shell.

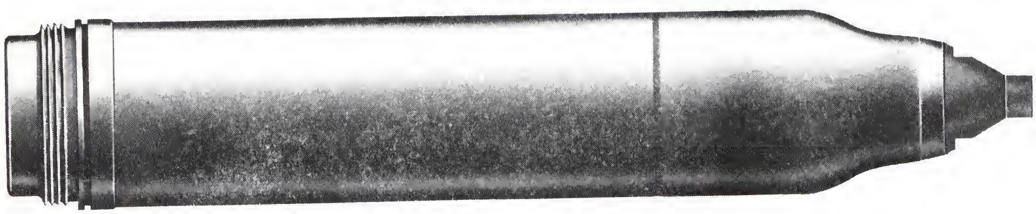


Figure 2-12. 5.0-Inch Rocket Warhead Mk 32 Mod 0 (ATAP), External View.

War head Type	HE	VT
Mark	32	32
Mod	0	0
Lot No. Prefix	RH2C	RH2D
List of Drawings	268535	268535
Loading Assembly No.	656891	656891
Overall Shipping Length (in.)	30.299	30.299
Length Without Details (approx)	29.112	29.112
Nominal Weight Shipped (lb)	46.16	46.16
Nominal Weight Fired (lb)	45.76	45.76
Filler:		
Type	Comp B	Comp B
Weight (lb)	15.00	15.00
Initiator-Booster Assembly:		
Type	Tetryl	Tetryl
Weight (lb)	0.30	0.30
Nose Fuze Mk-Mod	188-0	M414
Container Mk-Mod	31-0	31-1

2-10 5.0-INCH ROCKET WARHEAD MK 34 MOD 0 (SMOKE)

The 5.0-Inch Rocket Warhead Mk 34 Mod 0 is shown in figure 2-13.

This is the Mk 4 Mod 1 rocket warhead with head adapter (1517465) and fuze adapter (155626), shipped separately to be assembled in the field.

Figure 2-13. 5.0-Inch Rocket Warhead Mk 34 Mod 0 (SMOKE), External View.

Mark	34
Mod	0
Lot No. Prefix	RHCG
List of Drawings	174830
Loading Assembly No.	657056
Overall Shipping Length (in.)	40.457
Nominal Weight (lb)	51.94
Filler:	
Type	PWP
Weight (lb)	19.36
Nose Fuze Mk-Mod	188-0

Chapter 3

ROCKET MOTORS

3-1 FOLDING-FIN AIRCRAFT ROCKET MOTORS

The 2.75-inch and 5.0-inch motors are basically the same as the motors that power other aircraft rockets, except for the folding-fin apparatus.

3-1.1 MOTOR TUBE. The forward end of the tube, figure 3-1, is grooved internally to receive the lockwire that secures the warhead closure. The aft end, figure 3-1, has a similar groove for lockwire attachment of the nozzle-fin assembly. The tube is made of light gage aluminum since it does not support threads at either end and since the internal-burning propellant grain produces less heat on the walls of the tube than does an external-burning propellant grain.

3-1.2 HEAD CLOSURE. This component, figure 3-1, is grooved externally to receive the lockwire that secures it to the motor tube. On the

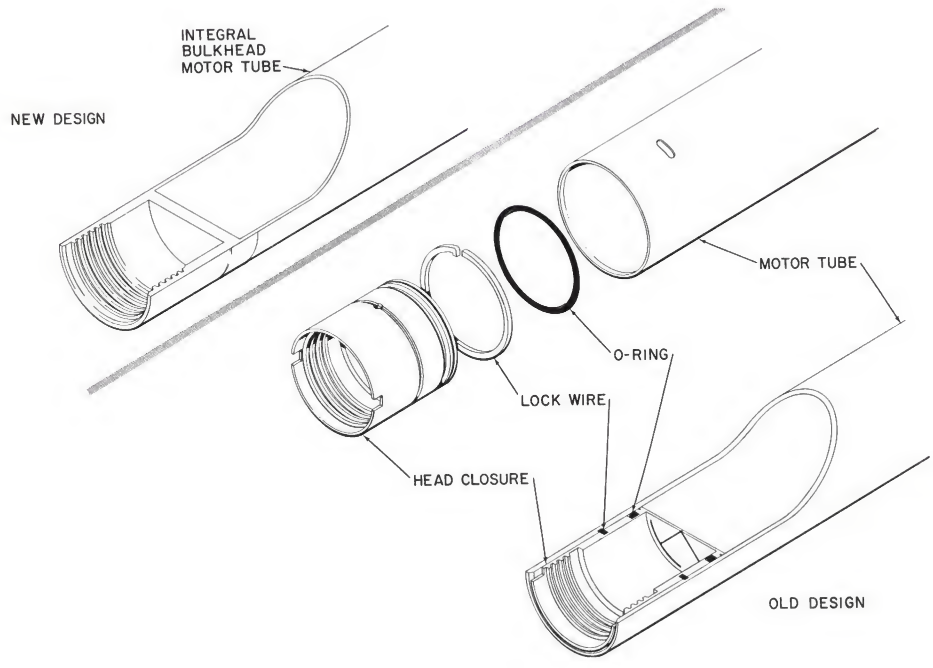


Figure 3-1. Components in Forward End of 2.75-Inch FFAR Motor, Showing Old and New Designs.

aft end is another groove fitted with a rubber O-ring that prevents the escape of gas from the tube during burning and serves as an atmospheric seal during storage. The aft end of the head closure is a thin disc that functions as a blowout diaphragm in case of accidental ignition prior to assembly of the warhead to the motor. The threads on the inside of the head closure receive the threads of the warhead in assembly of the complete round.

3-1.3 CHARGE SUPPORT DISC AND CHARGE SUPPORT RING. The glass fiber disc and the glass fiber ring between the head closure and the igniter serve to cushion the propellant grain against shocks and hold the igniter in place.

3-1.4 IGNITER. The Igniter Mk 125 is similar to most other aircraft rocket igniters. One of its leads is grounded to the nozzle plate and the other passes through a nozzle insert to a contact disc, figure 3-2, on the end of the nozzle-fin assembly. A blowout disc in the aft end of the igniter facilitates release of the flame and burning magnesium inside the igniter case when the igniter mixture, consisting primarily of black powder and magnesium, is initiated. For these igniters, a minimum firing current per round of 1.5 amperes for 10 milliseconds is required. The recommended firing current is 3 amperes per round. If the current is less than 1.5 amperes, a delay in ignition may be expected.

3-1.5 SPACER. The purpose of this double ring is to separate the forward end of the propellant grain and the charge support ring. This allows pressurization of the annular space around the propellant grain to support the propellant grain during firing.

3-1.6 STABILIZING ROD. This component eliminates resonance during burning and provides structural support for the igniter and igniter leads. Felt washers on the rod serve to position it in the center of the hole in the propellant grain. These washers are consumed in the burning of the propellant.

3-1.7 PROPELLANT GRAIN. This grain differs from the other aircraft

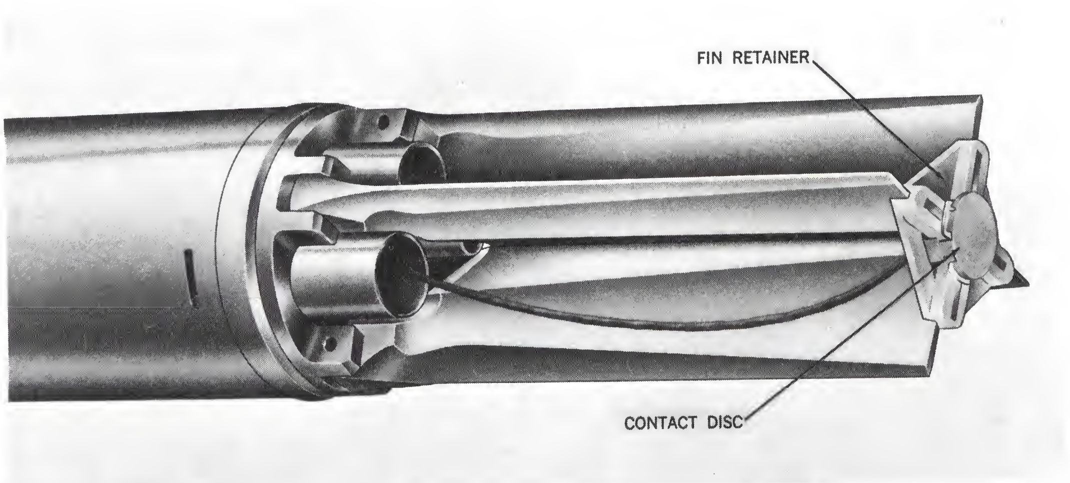


Figure 3-2. Nozzle-Fin Assembly, Fins Closed.

rocket grains in its physical shape and chemical composition (see figure 1-6). Substantially all of the external surface is coated with a plastic inhibitor to control the burning surfaces and resultant pressures. The internal perforation of the grain, where burning takes place, is an eight-point star configuration. Unlike some other cylindrical grains, there are no radial perforations in this type of grain. Some grains for the 2.75-inch rockets are made of N5 propellant, which is relatively insensitive to temperature changes; hence, the ballistics of these rounds are the same over a wide temperature range.

3-1.8 SEAL RING. A rubber ring fitted over the end sleeve next to the plastic ring prevents the escape of gas around the circumference of the nozzle plate while the propellant is burning; it also cushions the propellant against shocks from the rear.

3-1.9 NOZZLE-FIN ASSEMBLY. Th assembly is secured to the aft end o the motor tube by a lockwire, figure 3-3. A rubber O-ring seals the join against internal gas pressure during burning and provides an atmospheri seal during storage.

The nozzle-fin assembly consists basically of a nozzle plate, a fin-actuating mechanism, four fins, and a fin retainer.

3-1.9.1 Nozzle Plate. Unlike that of other aircraft rockets, the aft end o this nozzle plate, figure 3-3, extend past the end of the motor tube. This part of the nozzle plate is grooved externally to receive a latch that secures the round when loaded in a launcher. Fixed to the plate are fou inserts, or nozzles, which control the release of gases from the burnir propellant. In the center of the nozz plate is a cylinder which houses the piston that actuates the movable fins

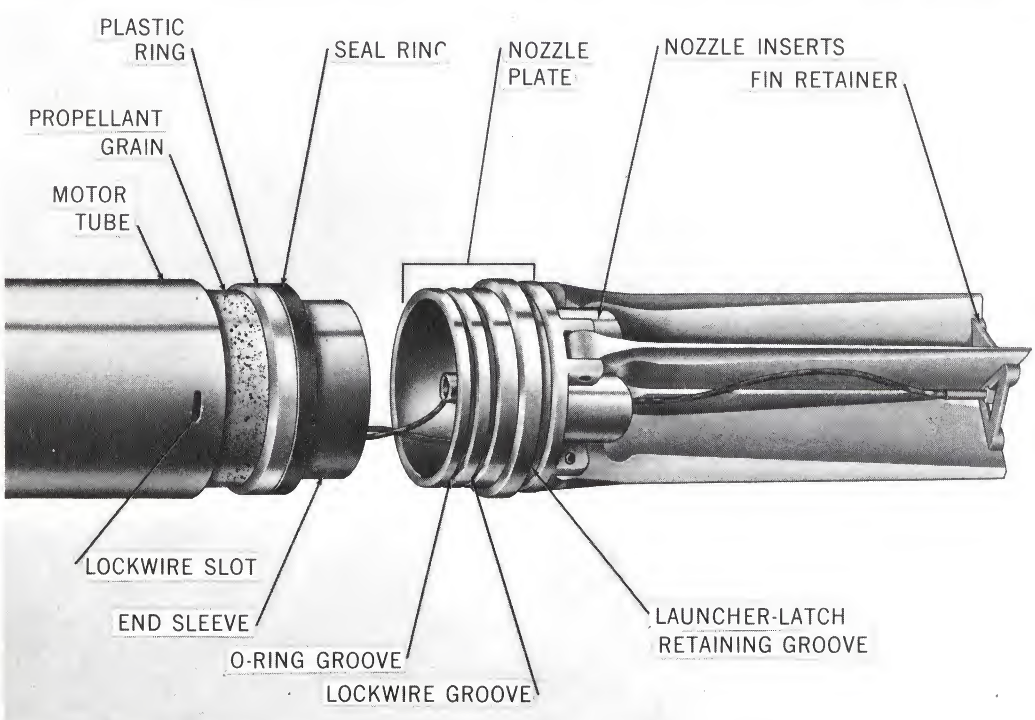


Figure 3-3. Nozzle-Fin Assembly and Aft End of 2.75-Inch FFAR Motor, With Propellant Grain Partially Out of Motor Tube.

3-1.9.2 Fin-Actuating Mechanism. The piston in the cylinder of the nozzle plate, figure 3-4, is attached to a crosshead at the aft end by an elastic stop nut. Gas pressure from the burning propellant moves the piston, pushing the crosshead against the heels of the fins and thereby opening the fins, figure 3-5. After the fins have opened, the crosshead moves into position to prevent the fins from closing.

3-1.9.3 Fins. The fins are shaped aluminum-alloy plates attached by pivot pins, figure 3-5, to lugs machined on the aft side of the nozzle plate. They are notched at the tips and on the trailing edges near the tip to fit the fin retainer.

3-1.9.4 Fin Retainer. The original fin retainers were of all steel construction but later ones were of plastic construction (see figures 3-2 and 3-3).

Both types are in current use. The purpose of these retainers is to hold the fins in the folded position. They are fitted with an insulated cadmium-plated brass contact disc which is connected to the live igniter lead.

3-1.10 SOLID BULKHEAD. The Rocket Motor Mk 4 Mod 8 is identical in performance and physical characteristics to other 2.75-inch rocket motors with the exception that the forward motor closure is designed in a manner that it will not rupture when the motor is fired without a warhead in place (see figure 3-1). This is accomplished by using a motor tube with an integral bulkhead similar to that in the 5.0-inch ZUNI. The motor is used exactly as other 2.75-inch motors. This motor is propulsive when ignited without the warhead attached.

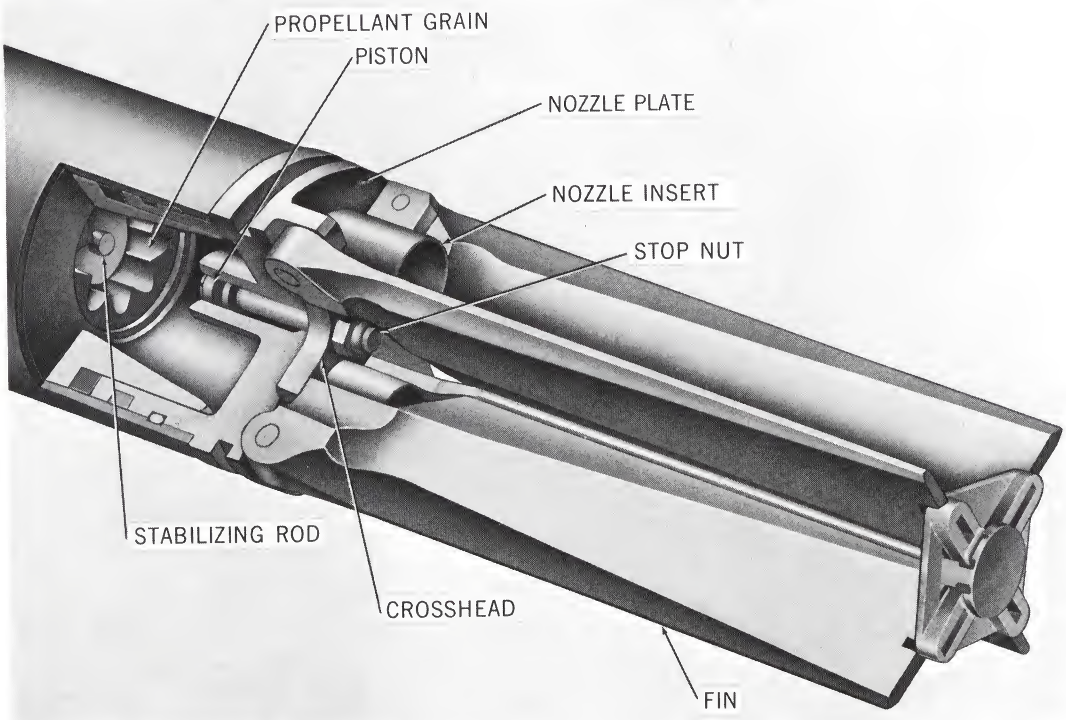


Figure 3-4. Nozzle-Fin Assembly, Cutaway View.

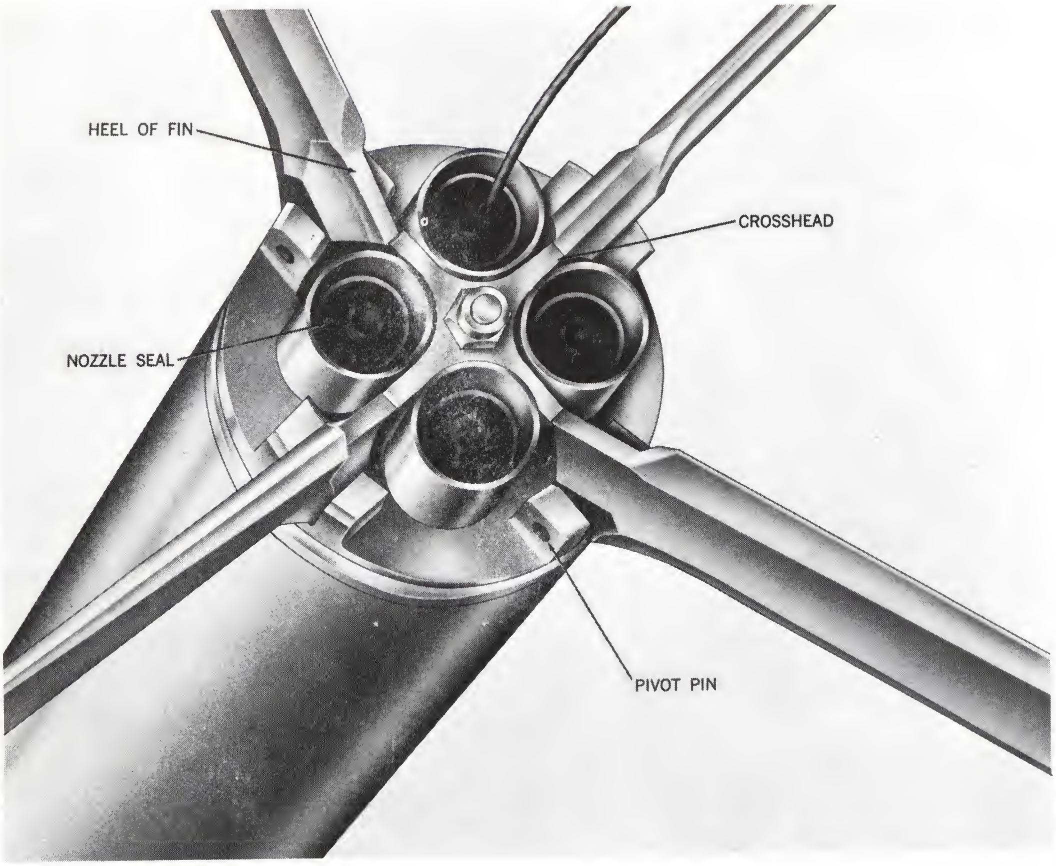


Figure 3-5. Fins in Flight Position.

3-2 2.75-INCH ROCKET MOTOR MK 1 MODS 3 AND 4

This motor, figure 3-6, shall be used for training purposes only. It is restricted to air-to-ground use wit[h] a motor temperature of 0 to 165°F.

A sectional view of the Motor Mk is illustrated in figure 3-7.

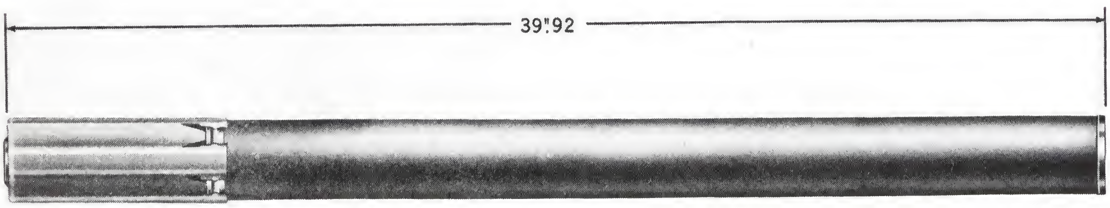


Figure 3-6. 2.75-Inch Rocket Motor Mk 1 Mod 3, External View, With Fin Protector in Place.

Mark	1	1
Mod	3	4
Lot No. Prefix	RMHA	RMHA
List of Drawings	174925	174994
Loading Assembly No.	656139	656688
Type Stabilization	Folding fin	Folding fin
Overall Shipping Length (in.)	39.92	39.92
Length Without Details (in.)	39.36	39.36
Nominal Weight Shipped (lb)	12.85	12.85
Nominal Weight Fired (lb)	11.52	11.52
Thrust (lb)	720	720
Largest Diameter as Shipped (in.)	3.01	3.01
Burning Time (sec)	1.69	1.69
Propellant Grain Mk-Mod	31-1	31-1
Igniter Mk-Mod	125-2	125-2

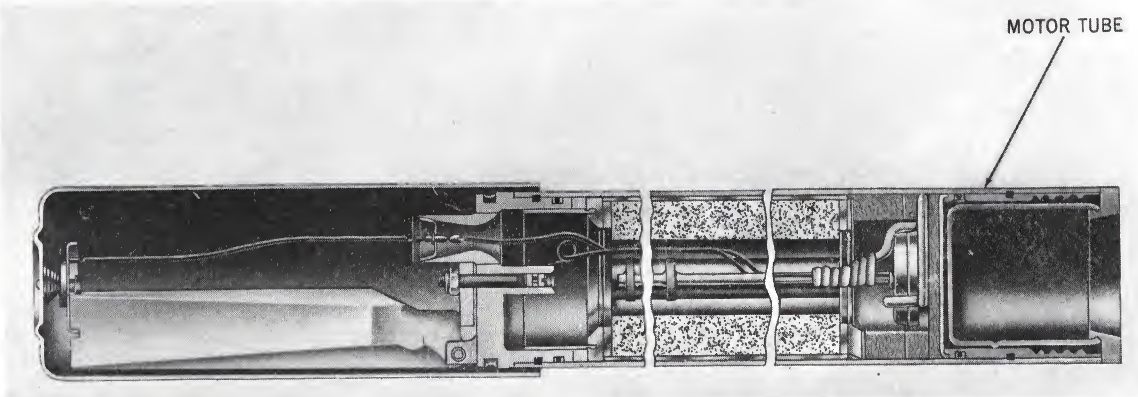


Figure 3-7. 2.75-Inch Rocket Motor Mk 1 Mod 4, Sectional View.

3-3 2.75-INCH ROCKET MOTOR MK 2 MODS 0, 1, 2, AND 3

The Motor Mk 2 Mod 3 is shown in figure 3-8.

A sectional view of the Motor Mk 2 Mod 3 is illustrated in figure 3-9.

The Mk 2 motor is limited to Fleet service or air-to-ground use. This motor is not temperature sensitive, but will cause jet-engine flameout if fired in salvos at altitudes greater than 20,000 feet.

The Propellant Grain Mk 43 all Mods used with the 2.75-Inch Rocket Motor Mk 2 is made of N5 propellant, which is relatively insensitive to temperature changes.

Mods 2 and 3 have a motor tube of clad aluminum. The Mod 3 differs from the Mod 2 in its propellant grain and in the use of a solid plastic cylinder instead of the metal end sleeve used in the Mod 2.

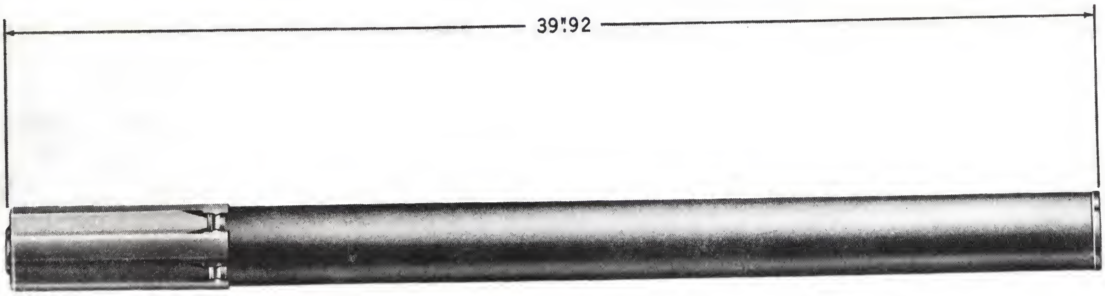


Figure 3-8. 2.75-Inch Rocket Motor Mk 2 Mod 3, External View, With Fin Protector in Place.

Mark	2	2	2	2
Mod	0	1	2	3
Lot No. Prefix	RMHA	RMHA	RMHA	RMHA
List of Drawings	175025	175013	175014	175024
Loading Assembly No.	656708	656696	656705	656707
Type Stabilization	Folding fin	Folding fin	Folding fin	Folding fin
Overall Shipping Length (in.)	39.92	39.92	39.92	39.92
Length Without Details (in.)	39.36	39.36	39. 36	39.36
Nominal Weight Shipped (lb)	12.62	12.62	12.62	12.62
Nominal Weight Fired (lb)	11.32	11.32	11.32	11.32
Thrust (lb)	720	720	720	720
Largest Diameter as Shipped (in.)	3.01	3.01	3.01	3.01
Burning Time (sec)	1.69	1.69	1.69	1.69
Propellant Grain Mk-Mod	43-0	43-1	43-0	43-1
Igniter Mk-Mod	125-2,4	125-2,4	125-2,4	125-2,4

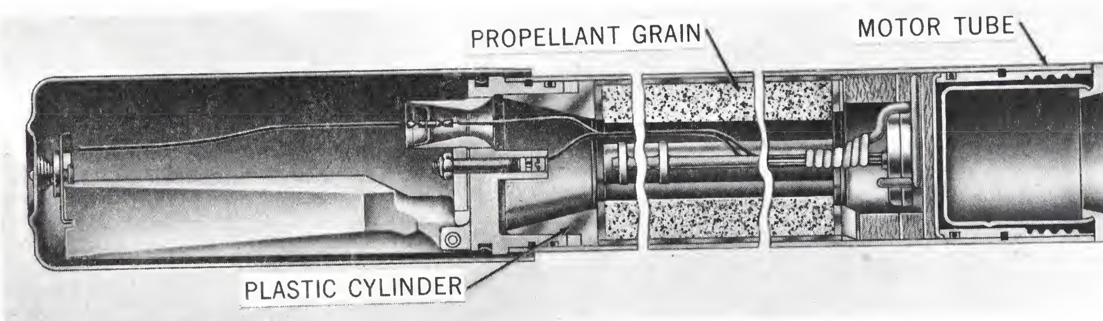


Figure 3-9. 2.75-Inch Rocket Motor Mk 2 Mod 3, Sectional View.

3-4 2.75-INCH ROCKET MOTOR MK 3 MODS 0, 1, 2, AND 3

The Mk 3 Mod 3 rocket motor is shown in figure 3-10.

A sectional view of the Mk 3 Mod 3 motor is illustrated in figure 3-11.

Propellant Grain Mk 43 all Mods used with the 2.75-Inch Rocket Moto Mk 3 is made of N5 propellant, whic is relatively insensitive to tempera ture changes.

The stabilizing rod in the Mk 3 motors is coated with potassium sa

to reduce aircraft engine flameout. The salt, when heated, releases oxygen to assist combustion of the propellant grain and to prevent oxygen starvation of the aircraft jet engine.

Mods 2 and 3 have a motor tube of clad aluminum. The Mod 3 differs from the Mod 2 in its propellant grain and in a solid plastic cylinder that replaces the metal end sleeve in the Mod 2.

The Mod 0 and Mod 1 have a motor tube made of aluminum alloy.

The Mk 3 motor is unacceptable for use in aircraft using internal launchers such as the F-102, F-86, and F-8. Mark 3 motors are satisfactory under all conditions if fired from expendable launchers, such as the Aero 6A, Aero 7D, and LAU-3/A.

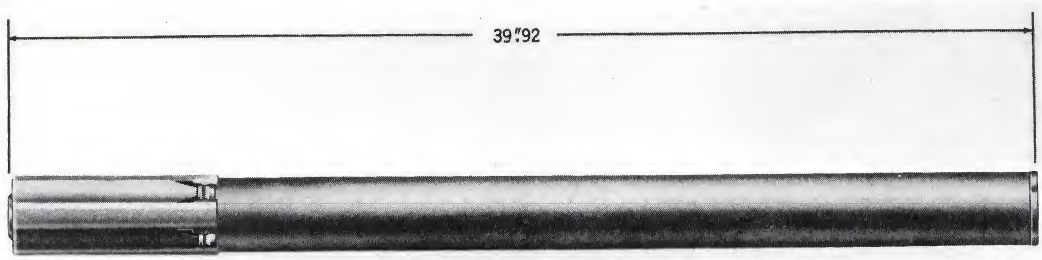


Figure 3-10. 2.75-Inch Rocket Motor Mk 3 Mod 3, External View, With Fin Protector in Place.

Mark	3	3	3	3
Mod	0	1	2	3
Lot No. Prefix	RMHA	RMHA	RMHA	RMHA
List of Drawings	268493	268494	268495	268496
Loading Assembly No.	656841	656842	656843	656844
Type Stabilization	Folding fin	Folding fin	Folding fin	Folding fin
Overall Shipping Length (in.)	39.92	39.92	39.92	39.92
Length Without Details (in.)	39.36	39.36	39.36	39.36
Nominal Weight Shipped (lb)	12.70	12.70	12.70	12.70
Nominal Weight Fired (lb)	11.40	11.40	11.40	11.40
Thrust (lb)	720	720	720	720
Largest Diameter as Shipped (in.)	3.01	3.01	3.01	3.01
Burning Time (sec)	1.69	1.69	1.69	1.69
Propellant Grain Mk-Mod	43-0	43-1	43-0	43-1
Igniter Mk-Mod	125-4	125-4	125-4	125-4

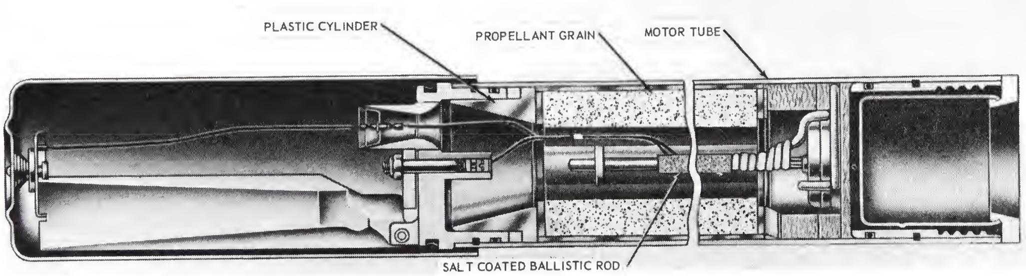


Figure 3-11. 2.75-Inch Rocket Motor Mk 3 Mod 3, Sectional View.

3-5 2.75-INCH ROCKET MOTOR MK 4 MODS 1 THROUGH 8

The Mk 4 Mod 0 rocket motor is shown in figure 3-12.

A sectional view of the Mk 4 Mod 0 motor is illustrated in figure 3-13.

A sectional view of the Mk 4 Mod 8 motor is shown in figure 3-14.

The Propellant Grain Mk 43 all Mods used with the 2.75-Inch Rocket Motor Mk 4 is made of N5 propellant, which is relatively insensitive to temperature changes.

The potassium salt coating on the stabilizing rod used in the Mk 4 motor is shorter than that used in the Mk 3 motor. This decreases the amount of corrosive salt deposited in the launcher. The salt, when heated, releases oxygen to assist combustion of the propellant grain and to prevent oxygen starvation of the aircraft jet engine.

Rocket Motor Mk 4 is used with all configurations of the 2.75-inch FFAR.

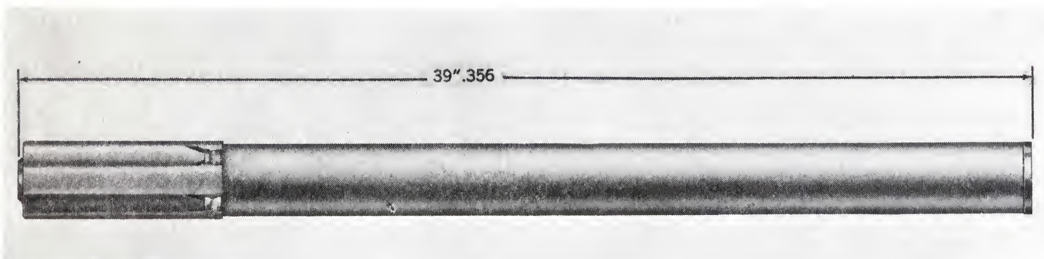


Figure 3-12. 2.75-Inch Rocket Motor Mk 4 Mod 0, External View, With Fin Protector in Place.

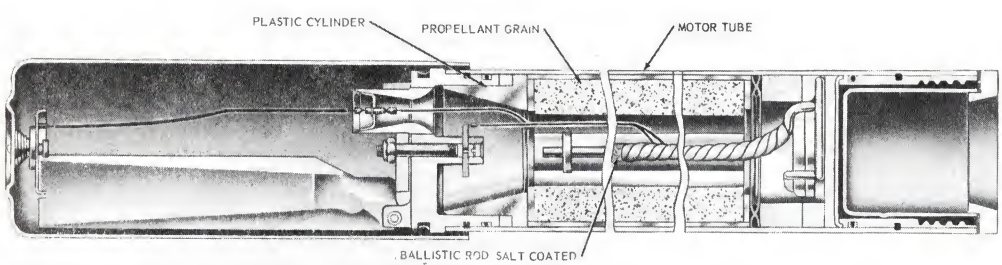


Figure 3-13. 2.75-Inch Rocket Motor Mk 4 Mod 0, Sectional View.

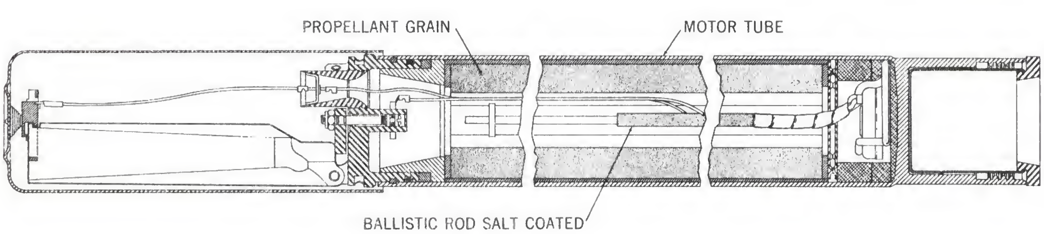


Figure 3-14. 2.75-Inch Rocket Motor Mk 4 Mod 8, Sectional View.

Mark	4	4	4	4	4	4	4	4	4
Mod	0	1	2	3	4	5	6	7	8
Lot No. Prefix	RMHA	RMHA	RMHA	RMHA	RMHA	RMHA	RMHA	RMHA	RMHA
List of Drawings	267914	267915	267916	267917	267918	267919	267920	267921	270349
Loading Assembly No.	657113	657114	657115	657116	657117	657118	657119	657120	1569418
Type Stabilization	Folding fin	Folding fin	Folding fin	Folding fin	Folding fin	Folding fin	Folding fin	Folding fin	Folding fin
Overall Shipping Length	39.92	39.92	39.92	39.92	39.92	39.92	39.92	39.92	39.92
Length Without Details (in.)	39.36	39.36	39.36	39.36	39.36	39.36	39.36	39.36	39.36
Nominal Weight Shipped (lb)	12.70	12.70	12.70	12.70	12.70	12.70	12.70	12.70	12.70
Nominal Weight Fired (lb)	11.40	11.40	11.40	11.40	11.40	11.40	11.40	11.40	11.40
Thrust (lb)	720	720	720	720	720	720	720	720	720
Largest Diameter as Shipped (in.)	3.01	3.01	3.01	3.01	3.01	3.01	3.01	3.01	3.01
Burning Time (sec)	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69	1.69
Propellant Grain Mk-Mod	43-0	43-0	43-0	43-0	43-1	43.1	43-1	43-1	43-1
Igniter Mk-Mod	125-4	125-4	125-4	125-4	125-4	125-4	125-4	125-4	125-4

3-6 2.75-INCH LOW-SPIN (LS) ROCKET MOTOR MK 40 MODS 0 AND 1

The Mk 40 motor is shown in figure 3-15.

A sectional view of the Mk 40 Mod 0 motor is illustrated in figure 3-16.

Propellant Grain Mk 43 all Mods used with the 2.75-Inch Rocket Motor Mk 40 is made of N5 propellant, which is relatively insensitive to temperature changes. The Mk 40 Mod 1 motor is identical with the Mk 4 Mod 8 except the nozzles are scarfed which causes it to spin.

A sectional view of the Mk 40 Mod 1 motor is illustrated in figure 3-17.

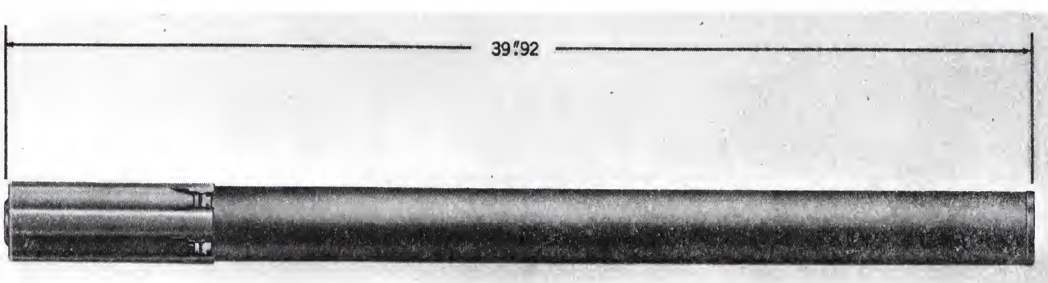


Figure 3-15. 2.75-Inch Rocket Motor Mk 40 Mod 0, External View.

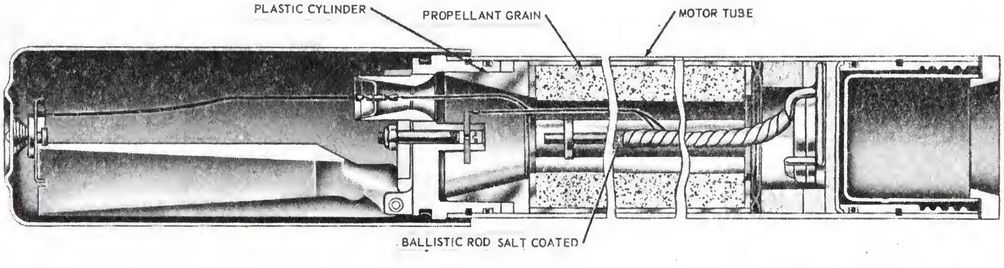


Figure 3-16. 2.75-Inch Rocket Motor Mk 40 Mod 0, Sectional View.

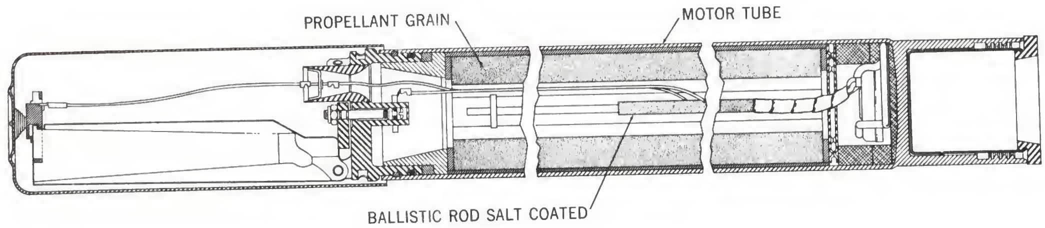


Figure 3-17. 2.75-Inch Rocket Motor Mk 40 Mod 1, Sectional View.

Mark	40	40
Mod	0	1
Lot No. Prefix	RMHA	RMHA
List of Drawings	1517506	1569446
Loading Assembly No.	1517506	1569446
Type Stabilization	Folding fin	Folding fin
Overall Shipping Length (in.)	39.92	39.92
Length Without Details (in.)	39.36	39.36
Nominal Weight Shipped (lb)	12.70	12.70
Nominal Weight Fired (lb)	11.40	11.40
Thrust (lb)	720	720
Largest Diameter as Shipped (in.)	3.01	3.01
Burning Time (sec)	1.69	1.69
Propellant Grain Mk-Mod	43-1	43-1
Igniter Mk-Mod	125-4	125-4

3-7 5.0-INCH ROCKET MOTOR MK 10 MOD 6

The Mk 10 Mod 6 motor is shown in figure 3-18.

A sectional view of the Mk 10 Mo motor is illustrated in figure 3-19.

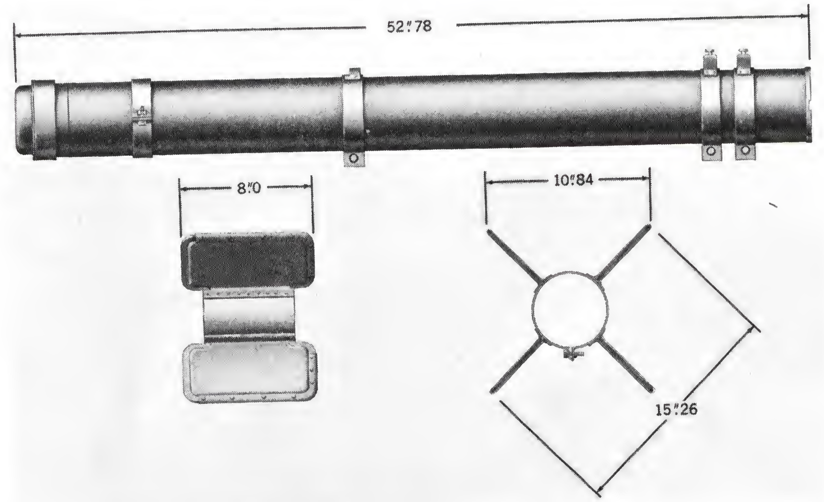


Figure 3-18. 5.0-Inch Rocket Motor Mk 10 Mod 6, External View.

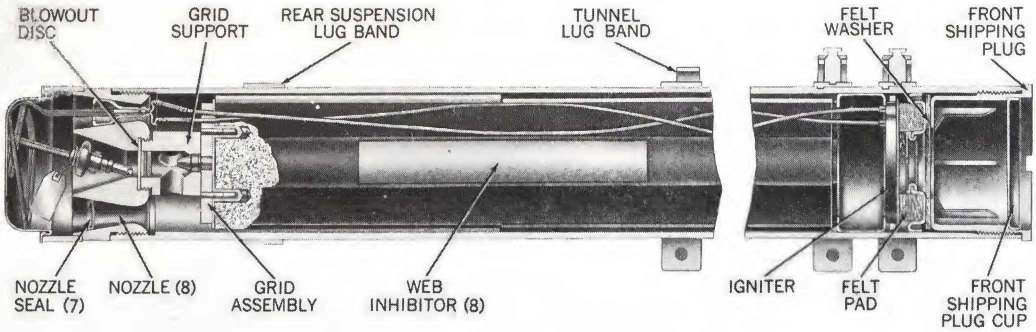


Figure 3-19. 5.0-Inch Rocket Motor Mk 10 Mod 6, Cross Section.

Mark	10
Mod	6
Loading Assembly No.	656724
List of Drawings	268439
Lot No. Prefix	RMDA
Type Stabilization	Fin
Nominal Weight Shipped (lb)	87.16
(with Fin Assembly)	92.66
Nominal Weight Fired (lb)	89.87
Thrust (lb)	4700
Overall Shipping Length (in.)	52.78
Length Without Details (in.)	51.31
Fin Diameter (in.)	15.26
Distance Between Lugs (in.)	Variable
Burning Time (sec)	1.15
Propellant Grain Mk-Mod	18-0
Igniter Mk-Mod	114-0 or 1
Electrical Connector:	
Mk-Mod	11-4
Length of Cable (in.) (approx)	27.35
Container Mk-Mod	6-0
Pallet Adapter Mk-Mod	8-0
Pallet Unit Load	1391943

This motor has a cruciform propellant grain and a jack plug electrical connector. The fin assembly is shipped either separately in Rocket Container Mk 6 Mod 0 or assembled to the motor when Pallet Adapter Mk 8 Mod 0 is used.

Suspension bands on this motor may be adjusted to fit various launchers.

3-8 5.0-INCH ROCKET MOTOR MK 16 MODS 1 AND 2

The Mk 16 Mod 1 motor is shown in figure 3-20.

3-8.1 GENERAL. Designed primarily for use with the 5.0-inch FFAR (ZUNI), the Motor Mk 16 Mods 1 and 2 use an internal-burning grain made

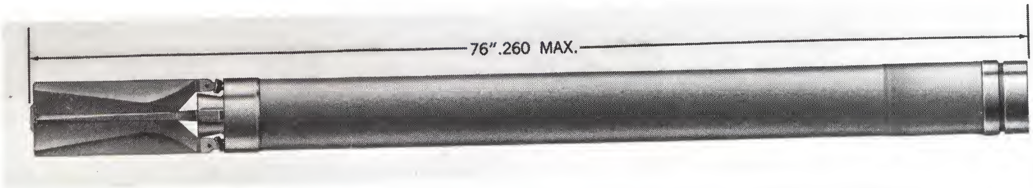


Figure 3-20. 5.0-Inch Rocket Motor Mk 16 Mod 1, External View.

Mark	16	16
Mod	1	2
Loading Assembly No.	657377	1517491
List of Drawings	267989	270002
Lot No. Prefix	RMZA	RMZA
Type Stabilization	Folding fin	Folding fin
Nominal Weight Shipped (lb) (approx)	56.5	56.5
Thrust (lb)	7500	7500
Overall Shipping Length (in.)	77.107	77.107
Length Without Details (in.)	76.260	76.260
Fin Diameter (in.)	27.171	27.171
Burning Time (sec)	1.04	1.04
Propellant Grain Mk-Mod	49-0	49-1
Igniter Mk-Mod	130-0	130-0
Maximum Diameter (in.)	5.125	5.125

of temperature-insensitive, low-flash, double-base propellant. The motor tube itself is lightweight aluminum alloy.

3-8.2 IGNITION. At the forward end of the motor tube are a detent groove and a contact band. The detent groove receives the detent latch in the LAU-10/A shipper-launcher package. The contact band is a steel strip insulated with a plastic sleeve.

3-8.3 MOTOR TUBE. The motor tube of the Mk 16 motor is of minimum wall thickness about the pressure chamber, but somewhat thicker at the ends. Special standard acme threads at each end join the warhead and the nozzle to the motor. At the forward end of the motor tube is a solid bulkhead. A blowout disc is not required because of the motor tube rupturing feature.

3-8.4 PROPELLANT. Solventless extruded from N4 propellant, the star-perforated propellant grain used with Rocket Motor Mk 16 burns fast, but with relatively cool, clean, non-corrosive exhaust. The grain is cyl indrical and spiral-wrapped with a plastic inhibitor that covers most of the external surface of the grain. A salt-coated ballistic rod suspended in the grain perforation reduces flas and afterburning, which contribute t compressor stall (flameout) on jet aircraft.

3-8.5 IGNITER. Rocket Motor Mk 1 uses a tin-can type igniter loaded with FFFG black powder and flaked magnesium. The igniter is initiated by the Squib Mk 1 Mod 0, and ignite the grain by sending a sheet of flam and burning magnesium particles down the perforation.

At the after end of Rocket Motor Mk 16 are four blast-operated fins. These fins are tapered aluminum-a blades; the heels lie over the nozzle cone. The first motor gases kick th fins open to latch on ratchet pawls. small plastic fin retainer disc holds the fins closed before motor firing.

Chapter 4

ROCKET FUZES

4-1 NOSE FUZE MK 149 MODS 0 AND 1 (SETBACK-AND-AIR-ARMING, IMPACT-FIRING)

The Nose Fuze Mk 149 Mod 1 is shown in figure 4-1.

A sectional view of the Mk 149 nose fuze is illustrated in figure 4-2.

This fuze is exactly like the typic setback-and-air-arming nose fuze described in paragraph 1-15.1. The firing pin of the Mod 1 is drilled longitudinally to make it collapse in its well in the shutter if the fuze is dropped accidentally while in the un armed condition. This collapsing pr vents it from accidentally initiating the booster lead-in. The firing pin c the Mod 0 is not drilled.

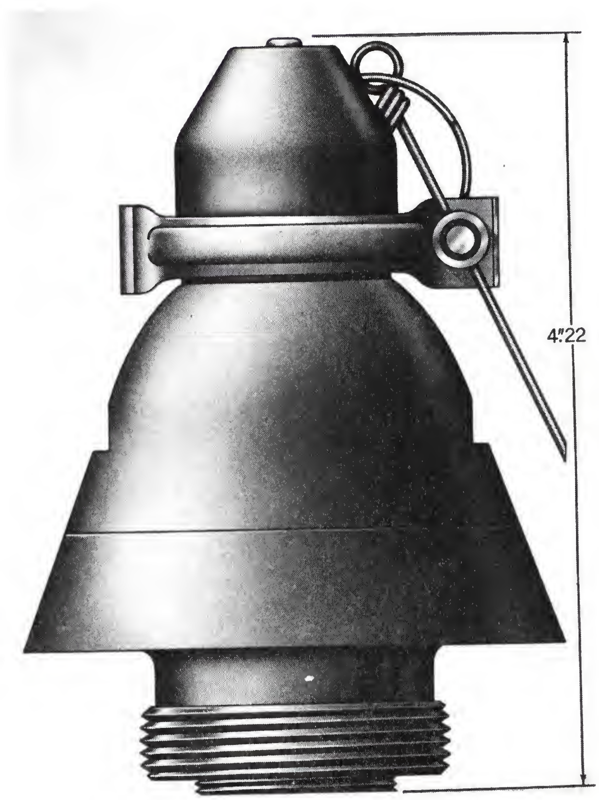


Figure 4-1. Nose Fuze Mk 149 Mod 1, External View.

Mark	149	149
Mod	0	1
General Arrangement	393783	978604
List of Drawings	109204	284796
Ordnance Specifications	3388	3388
Nominal Weight (lb)	2.6	2.6
Overall Length (in.)	4.22	4.22
Armed by	Setback and air vanes	Setback and air vanes
Fired by	Impact	Impact
Delay Time (sec)	Instantaneous	Instantaneous
Sensitive to Firing on Water Impact	Yes	Yes
Explosive Components:		
Detonator		
Type	Lead azide primer mixture, lead azide, and tetryl	Lead azide primer mixture, lead azide, and tetryl
Mk-Mod	23-0	23-0
Booster Lead-in	Tetryl	Tetryl
Booster	Tetryl (approx 9 gm)	Tetryl (approx 9 gm)
Packaging:		
Inner Container Mk-Mod	39-0	39-0
Outer Container Mk-Mod	18-0	18-0

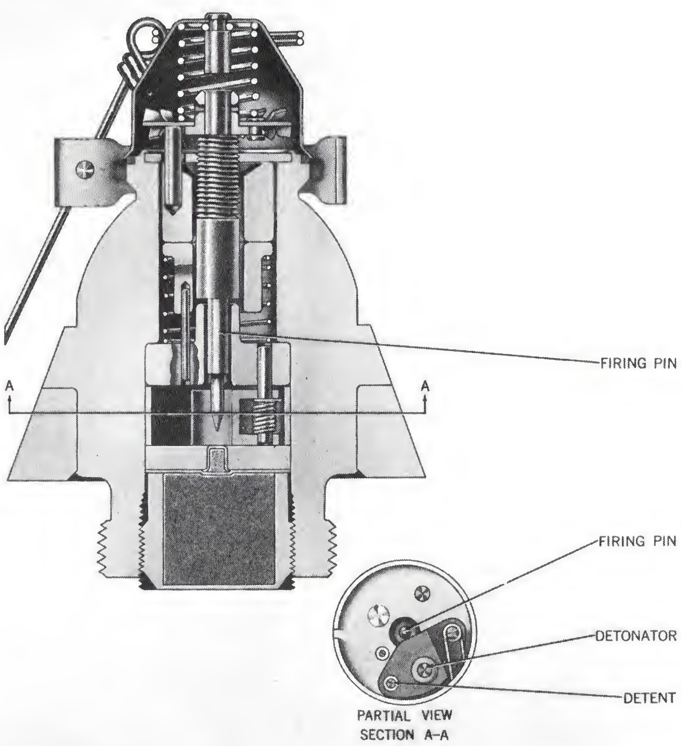


Figure 4-2. Nose Fuze Mk 149 Mod 1, Unarmed Position, Cross Section.

4-2 NOSE (VT) FUZE MK 172 MOD 2 (PROXIMITY-FIRING)

The Mk 172 Mod 2 nose (VT) fuze is shown in figure 4-3.

Nose VT Fuze Mk 172 Mod 2 is designed for air-to-ground firing where air bursts are necessary to spray fragments on personnel or light equipment. This fuze may be used (however, less successfully) in air-to-air firing, but the rocket must come wi in 20 feet of the aircraft target bef the fuze will function.

This fuze must not be used if th seal wire which is shipped with it i broken. Inspect for such defects in mediately upon removal from the c tainer.

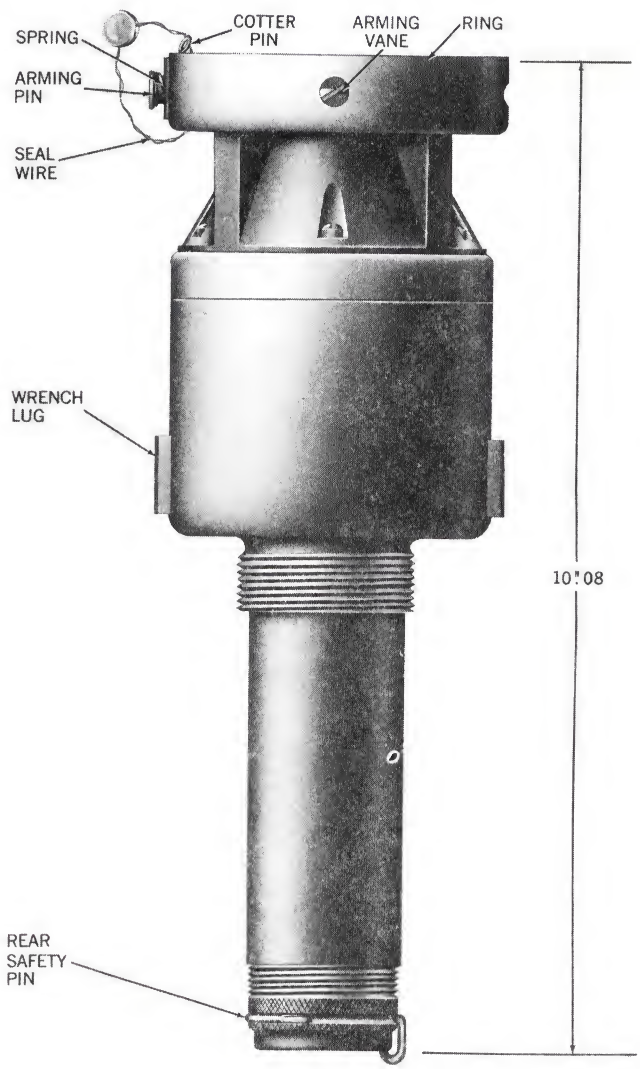


Figure 4-3. Nose (VT) Fuze Mk 172 Mod 2, External View.

4-3 NOSE (VT) FUZE (PROXIMITY FIRING)

The Nose (VT) Fuze M414 is shown in figure 4-4.

The M414 fuze is designed for use with Warheads Mk 24 and Mk 32, used with the 5.0-inch FFAR (ZUNI). It is especially effective against aircraft. In air-to-air firing, the M414 fuze functions within 40 feet of the aircraft, a near enough miss, when used with Warhead Mk 32, to kill a heavy bomber.

Mark	M414
Mod	0
General Arrangement	D7544420
Nominal Weight (lb)	2.6
Overall Length (in.)	9.175
Delay Time (sec)	8-10
Explosive Components:	
Primer:	
Type	Electric; lead azide, lead styphnate, PETN
Detonator:	
Type	Electric
Mk-Mod	T79-0
Booster and Lead-in	Tetryl

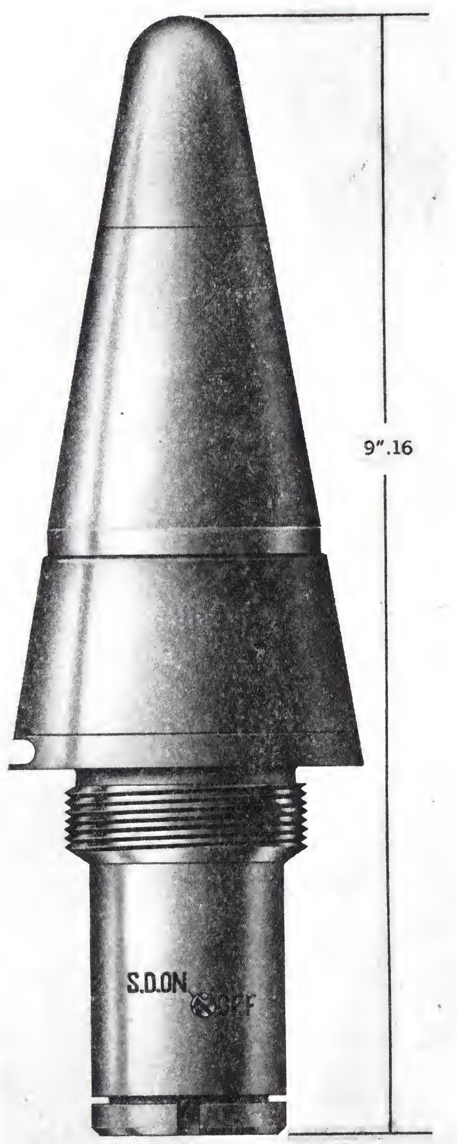


Figure 4-4. Nose (VT) Fuze M414, External View.

Since the M414 fuze is used with shipper-launcher-packages, it has no external arming devices. Its electronic components are completely enclosed in a blunt-nosed, ogival, fuze head.

4-4 NOSE FUZE MK 176 MODS 0 AND 1 (ACCELERATION-ARMING, POINT-DETONATING)

The Nose Fuze Mk 176 Mod 1 is shown in figure 4-5.

Mark	176	176
Mod	0	1
General Arrangement	656269	657739
List of Drawings	174737	268456
Nominal Weight (lb)	0.75	0.75
Overall Length (in.)	3.01	3.01
Delay Time (sec)	0.0004	0.0004
Sensitive to Firing on Water Impact	No	No
Explosive Components:		
Primer:		
Type	Lead azide primer mix and lead azide	Lead azide primer mix and lead azide
Mk-Mod	125-0	125-0
Delay Element:		
Type	Lead peroxide, nickel, and zirconium	Lead peroxide nickel, and zirconium
Mk-Mod	10-0	10-0
Detonator:		
Type	Tetryl and lead azide	Tetryl and lead azide
Mk-Mod	59-0	59-0
Booster and Lead-in	Tetryl	Tetryl

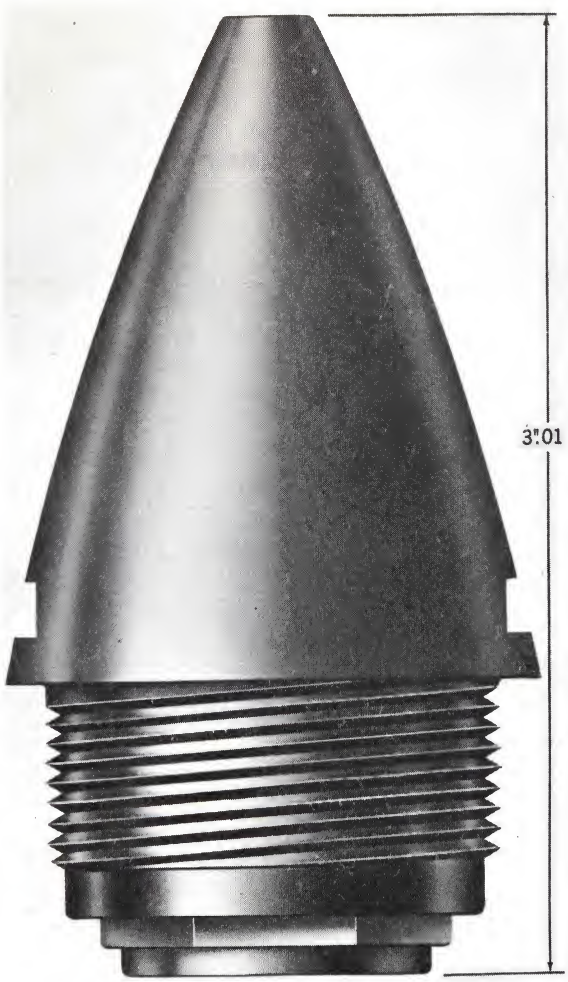


Figure 4-5. Nose Fuze Mk 176 Mod 1, External View

A sectional view of the Nose Fuze Mk 176 Mod 1 is given in figure 4-6.

Nose Fuze Mk 176 is generally similar to the typical acceleration-arming, point-detonating nose fuze described in paragraph 1-15.2. However, in the Mk 176 fuze, which is designed for delayed action, there is a delay element in the rotor between the primer and the detonator. The rotor is not drilled completely throu a thin diaphragm is left between the well for the primer and the well for the delay element and the detonator. When the primer is initiated by the firing pin, the detonation collapses t diaphragm. The movement of the diaphragm initiates the pressure-sensitive delay element.

The Mod 1 is the production mod of this fuze; its timing gear train en bodies a balanced escapement. The Mod 0 was the first lot made; its timing mechanism did not include th balanced escapement.

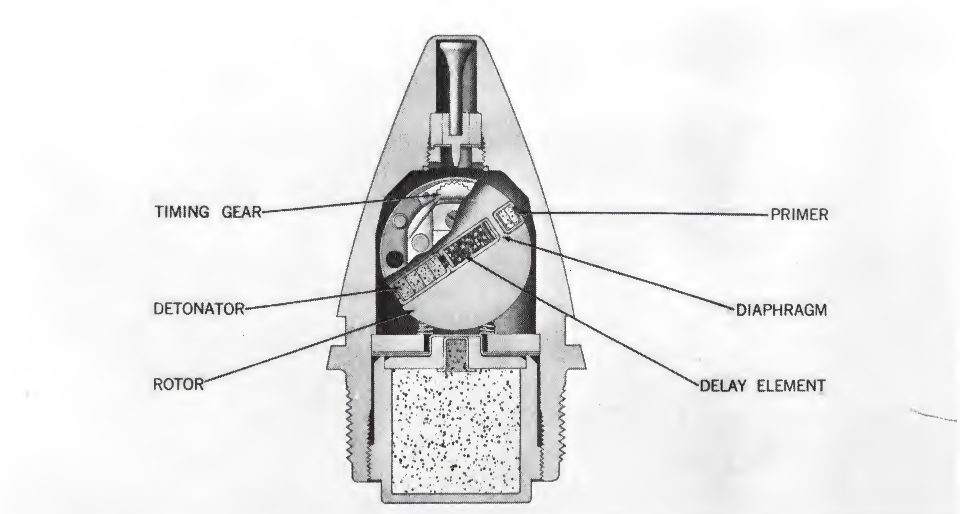


Figure 4-6. Nose Fuze Mk 176 Mod 1, Unarmed Position, Sectional View.

4-5 NOSE FUZE MK 178 MODS 0, 1, AND 2 (ACCELERATION-ARMING, POINT-DETONATING)

The Nose Fuze Mk 178 Mod 2 is shown in figure 4-7.

A sectional view of the Mk 178 Mod 2 is illustrated in figure 4-8.

Nose Fuze Mk 178 is similar to the typical acceleration-arming, point-detonating nose fuze described in paragraph 1-15.2. In the Mk 178 fuze, which is designed for instantaneous action, there is no delay element in the rotor between the primer and the detonator. The rotor is drilled to provide a flash channel from the primer to the detonator.

The Mod 0 employs a rotor built for the Mk 176 fuze which is drilled and fitted with a sleeve for the instantaneous explosive train of the Mk 178. The Mod 1 employs a rotor especially produced for ths type of action; no sleeve is necessary. The Mod 2, though not in production, is the approved production model of the fuze; it incorporates the new rotor, a balanced escapement in the timing mechanism, and a diecast booster cup.

This fuze may be used in conjunction with the low-spin (LS) 2.75-Inch Mk 4 or Mk 40 rocket motor; tests have indicated no adverse effects on the fuze relative to arming time as a result of in-flight spinning.

Figure 4-7. Nose Fuze Mk 178 Mod 2, External View.

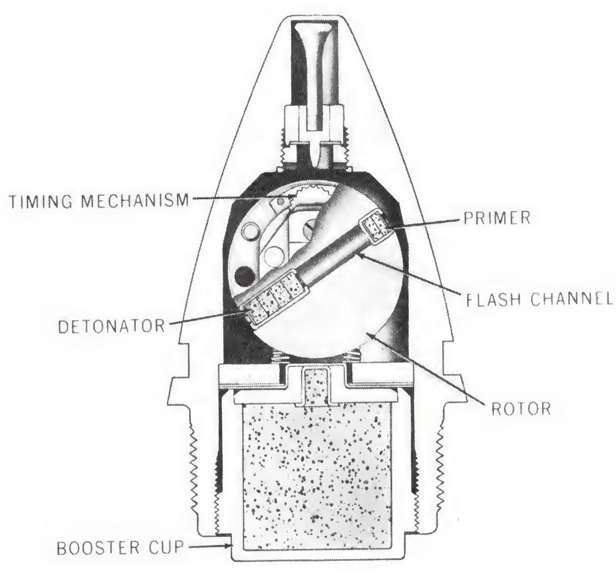


Figure 4-8. Nose Fuze Mk 178 Mod 2, Unarmed Position, Sectional View.

Mark	178	178	178
Mod	0	1	2
General Arrangement	657178	656065	657740
List of Drawings	174862	174812	175374
Nominal Weight (lb)	0.75	0.75	0.75
Overall Length (in.)	3.01	3.01	3.01
Delay Time (sec)	None	None	None
Sensitive to Firing on Water Impact	No	No	No
Explosive Components:			
Primer:			
Type	Lead azide primer mix and lead azide	Lead azide primer mix and lead azide	Lead azide primer mix and lead azide
Mk-Mod	125-0	125-0	125-0
Detonator:			
Type	Tetryl and lead azide	Tetryl and lead azide	Tetryl and lead azide
Mk-Mod	59-0	59-0	59-0
Booster and Lead-in	Tetryl	Tetryl	Tetryl

4-6 NOSE FUZE MK 181 MOD 0 (ACCELERATION-ARMING, POINT-INITIATING, BASE-DETONATING)

The Nose Fuze Mk 181 Mod 0 is illustrated in figure 4-9.

A sectional view of the Mk 181 Mod 0 is shown in figure 4-10.

The major innovations in the Nos Fuze Mk 181 are the impact-sensitiv primer, the absence of a firing pin, and the shaped-charge booster.

The primer is protected from ac cidental ignition by an air gap betwe the windshield and that part of the fu body which houses the primer. At in pact velocities as great as 3000 fps, the fuze will function against such targets as earth or mild steel plate of a minimum thickness of 0.125 incl On plate targets, it will function at angles-of-attack between 0 and 60 degrees from the perpendicular to th plate.

Figure 4-9. Nose Fuze Mk 181 Mod 0, External View.

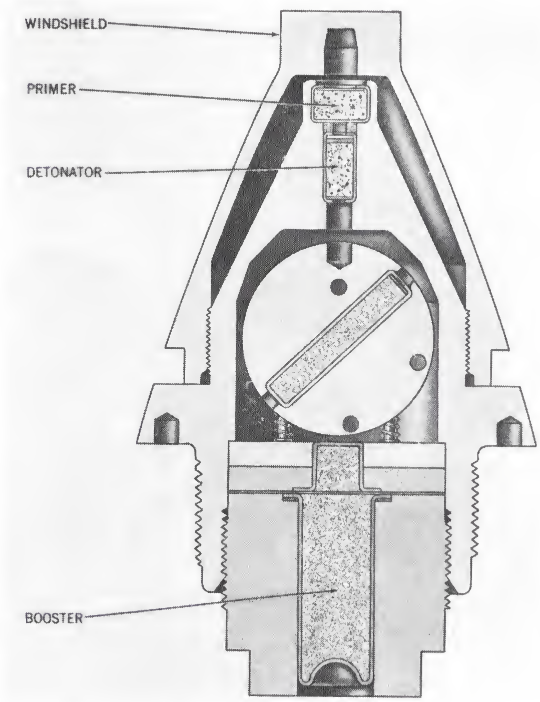


Figure 4-10. Nose Fuze Mk 181 Mod 0, Unarmed Position, Sectional View.

Mark	181
Mod	0
General Arrangement	1378092
List of Drawings	291708
Nominal Weight (lb)	0.82
Overall Length (in.)	3.365
Delay Time (sec)	None
Sensitive to Firing on Water Impact	No
Explosive Components:	
Primer:	
Type	Potassium chlorate, antimony sulfide, lead thiocyanate, and lead azide
Model	M 56
Detonator:	
Type	Potassium chlorate, antimony sulfide, lead azide, tetryl, and carborundum
Model	M 29
Lead-ins (2)	RDX mix
Booster:	
Type	RDX mix, shaped charge
Model	M 122

The shaped-charge Booster M 122 has a concave shape at its aft end to direct the explosion of the booster into a jet of high temperature gases. This jet travels to the base of the rocket head, through the cone and flash tube, to ignite the booster pellet and, in turn, the main charge.

Nose Fuze Mk 181 is coated with an organic sealing compound to prevent the entry of moisture and to prolong the effectiveness of the explosive components during storage.

4-7 NOSE FUZE MK 188 MOD 0 (ACCELERATION-ARMING, POINT-DETONATING)

The Nose Fuze Mk 188 Mod 0 is shown in figure 4-11.

A sectional view of the Mk 188 Mod 0 is shown in figure 4-12.

Nose Fuze Mk 188 Mod 0 is designed for use with Rocket Warhead

Figure 4-11. Nose Fuze Mk 188 Mod 0, External View.

Mark	188
Mod	0
General Arrangement	657678
List of Drawings	175379
Nominal Weight (lb)	0.75
Overall Length (in.)	5.11
Delay Time	None
Sensitive to Firing on Water Impact	Yes
Explosive Components:	
Primer:	
Type	Lead azide primer mix and lead azide
Mk-Mod	125-0
Detonator:	
Type	Tetryl and lead azide
Mk-Mod	59-0
Booster and Lead-in	Tetryl

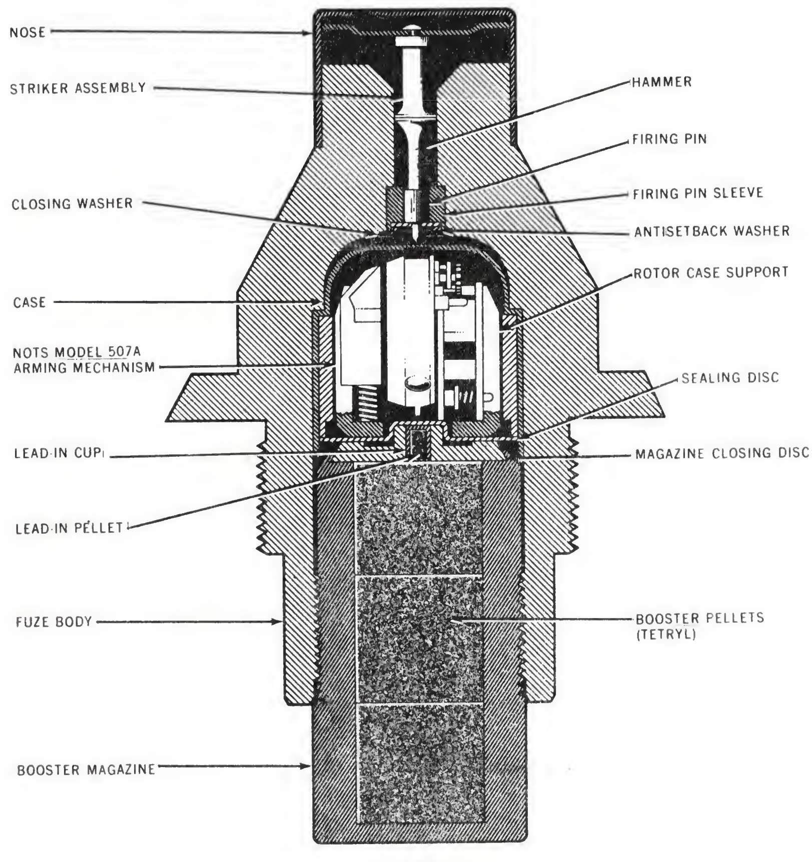


Figure 4-12. Nose Fuze Mk 188 Mod 0, Unarmed Position, Sectional View.

Mk 24 Mod 0, used in conjunction with the 5.0-inch FFAR (ZUNI). The only distinctions to be made between this fuze and other acceleration-arming, impact-firing, point-detonating fuzes are in the firing pin assembly design, dimensions, and actual physical appearance. Because of the design of the nose and striker assembly this

fuze is capable of functioning at low angles of obliquity. Nose Fuze Mk 188 Mod 0 contains the same basic components as the other acceleration-arming fuzes. The functional characteristics of the Nose Fuze Mk 188 are typical, as described in paragraph 1-15.2.

4-8 BASE FUZE MK 164 MOD 0 (PRESSURE-ARMING, IMPACT-FIRING)

The Base Fuze Mk 164 Mod 0 is shown in figure 4-13.

A sectional view is illustrated in figure 4-14.

This fuze is exactly like the typical pressure-arming, impact-firing base fuze described, paragraph 1-15.3.

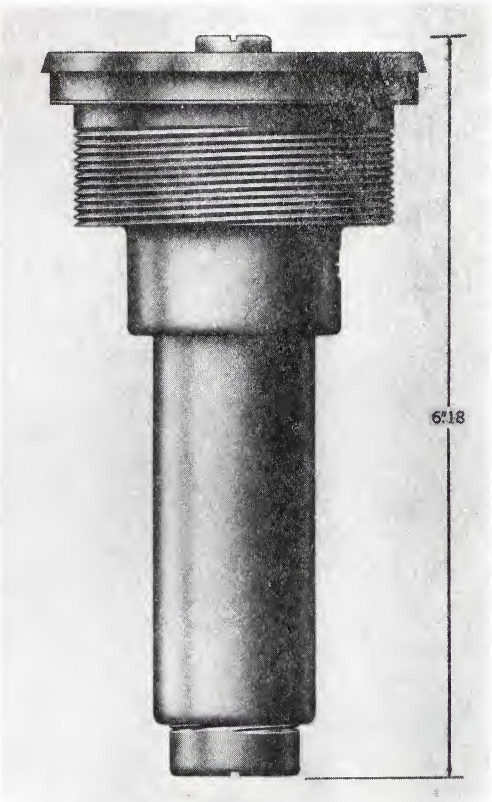


Figure 4-13. Base Fuze Mk 164 Mod 0, External View.

Mark	164
Mod	0
General Arrangement	561460
List of Drawings	165239
Ordnance Specifications	3675
Nominal Weight (lb)	3.45
Overall Length (in.)	6.18
Armed by	Motor-gas pressure
Fired by	Impact
Delay Time (sec)	0.015
Sensitive to Firing on Water Impact	Yes
Explosive Components:	
Delay Element Mk-Mod	7-0
Percussion Primer:	
Type	Mercury fulminate
Mk-Mod	106-0
Delay Charge	Black powder
Relay Detonator:	
Type	Lead azide
Mk-Mod	42-0
Booster Lead-in	Tetryl
Booster	Tetryl (approx 12 gm)
Packaging:	
Inner Container Mk-Mod	35-0
Outer Container Mk-Mod	36-0

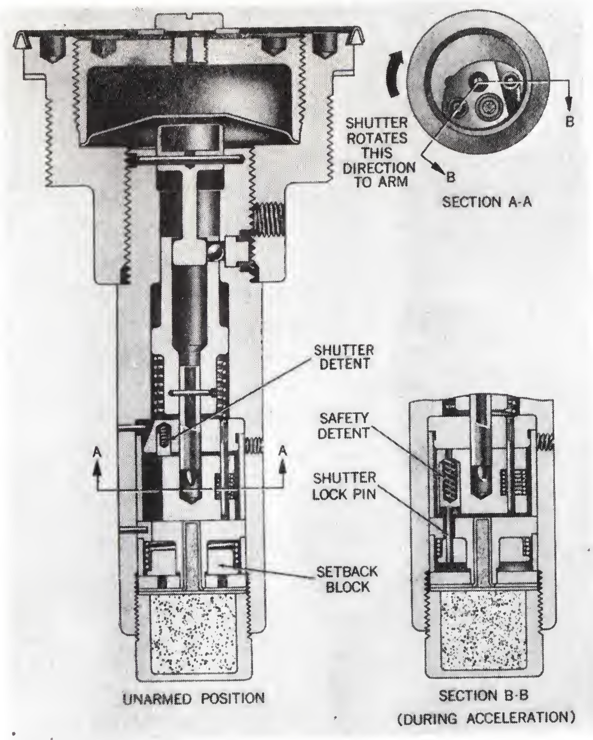


Figure 4-14. Base Fuze Mk 164 Mod 0, Unarmed Position, Cross Section.

4-9 BASE FUZE MK 191 MOD 1 (ACCELERATION-ARMING, IMPACT-FIRING)

The Base Fuze Mk 191 Mod 1 is illustrated in figure 4-15.

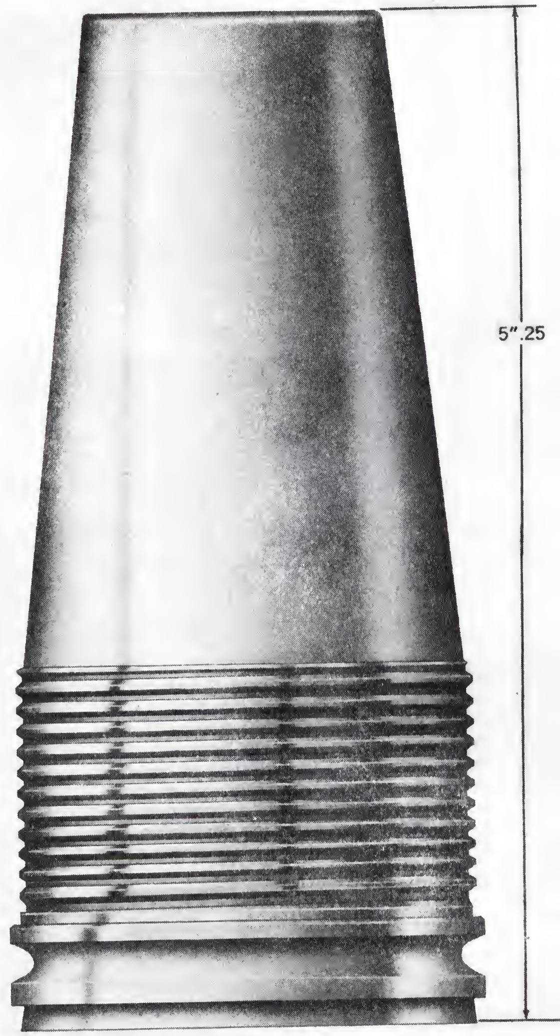


Figure 4-15. Base Fuze Mk 191 Mod 1, External View

Mark	191
Mod	1
General Arrangement	1442147
List of Drawings	S95990
Nominal Weight (lb)	3.75
Overall Length (in.)	5.260
Delay Time (sec)	0.005
Sensitive to Firing on Water Impact	No
Explosive Components:	
Primer:	
Type	Lead azide, lead styphnate, and tetracene
Mk-Mod	134-0
Detonator:	
Type	Lead azide and tetryl
Mk-Mod	59-0
Booster and Lead-in	Tetryl

A sectional view of the Mk 191 Mod 1 is shown in figure 4-16.

Base Fuze Mk 191 Mod 1 is designed for use with the Rocket Warhead Mk 24 for the 5.0-inch FFAR (ZUNI). This fuze is distinguished by its electrical operation through which its electrical energy is obtained by the use of a magnetic impulse generator (MIG) which does not require prelaunching charging but, instead, impact-energizes the primer initiating circuit.

When penetration of a hard target is desired, the nose fuze of the Mk 24 warhead is replaced with a hardened steel ogive (dwg 458162), and the Mk 191 fuze supplies delayed detonation after the head has penetrated the target.

The fuze is permanently screwed into the base of the head at the loading depot. It should NEVER be removed in the field. If this fuze is not in place in the base of the Mk 24 rocket warhead, the warhead shall not be used, as a missing base fuze may cause loss of life and property resulting from a premature detonation when a launch is attempted from the firing aircraft.

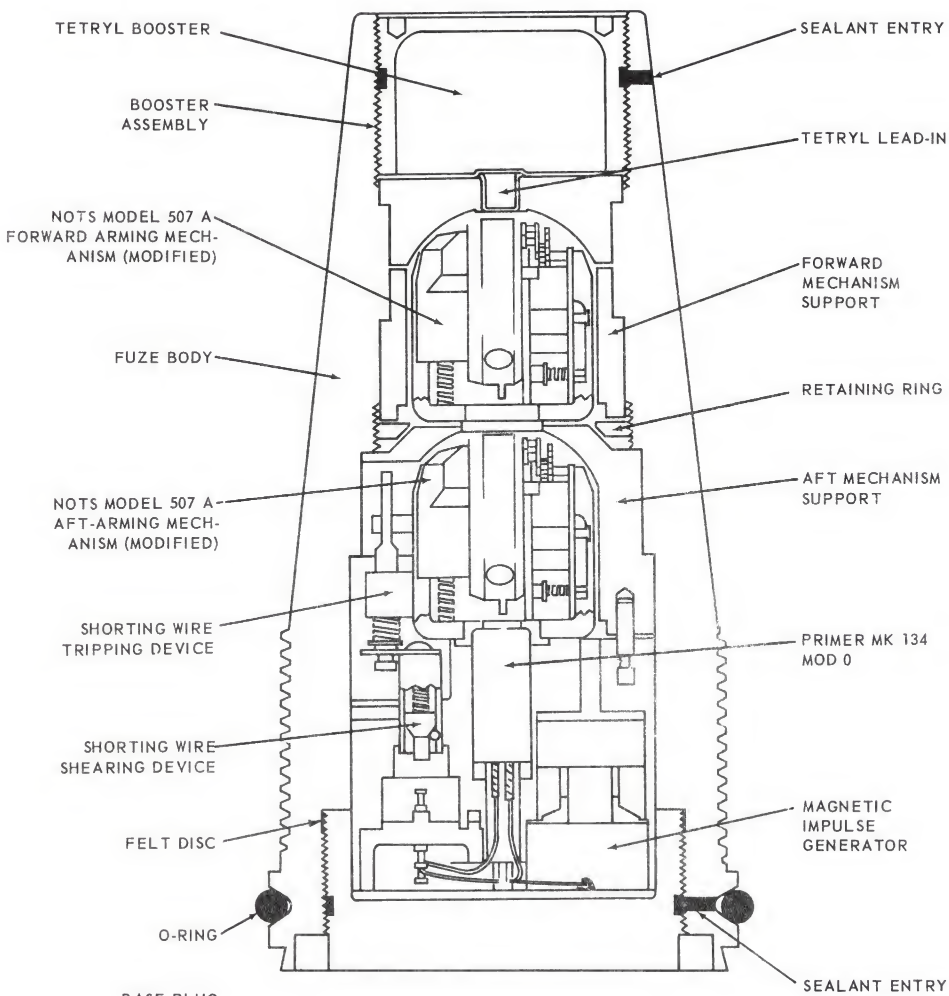


Figure 4-16. Base Fuze Mk 191 Mod 1, Unarmed Position, Sectional View.

4-10 BASE FUZE MK 166 MODS 0 AND 2 (PRESSURE-ARMING, DECELERATION-FIRING)

The Base Fuze Mk 166 Mod 2 is shown in figure 4-17.

A sectional view of the Mk 166 Mod 2 base fuze is shown in figure 4-18.

This fuze is exactly like the typical pressure-arming, deceleration-firing base fuze described, paragraph 1-15.3.

The Mod 2 differs from the Mod 0 in the following respects:

1. The Mod 2 has Primer Mk 102 Mod 1 instead of the Mk 102 Mod 0 in the Mod 0 fuze.

Mark	166	166
Mod	0	2
General Arrangement	562011	978505
List of Drawings	165443	284523
Ordnance Specifications	3906	5371
Nominal Weight (lb)	3.90	3.90
Overall Length (in.)	6.49	6.49
Armed by	Motor-gas pressure	Motor-gas pressure
Fired by	Deceleration	Deceleration
Sensitive to Firing on Water Impact	No	No
Explosive Components:		
Sensitive Primer:		
Type	Mercury fulminate	Mercury fulminate
Mk-Mod	102-0	102-1
Detonator:		
Type	Lead azide	Lead azide
Mk-Mod	33-1	33-1
Body Lead-ins (2)	Tetryl	Tetryl
Body Lead-outs (2)	Tetryl	Tetryl
Booster	Tetryl (approx 28 gm)	Tetryl (approx 28 gm)
Packaging:		
Inner Container Mk-Mod	56-0	56-0
Outer Container	57-0	57-0

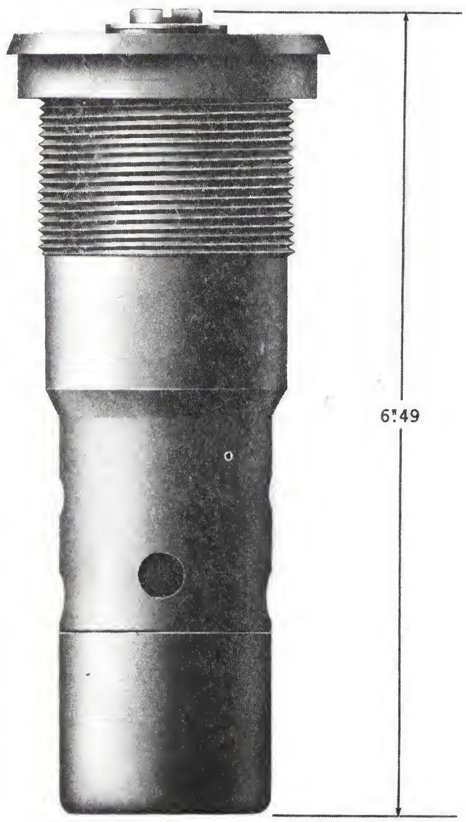


Figure 4-17. Base Fuze Mk 166 Mod 2, External View.

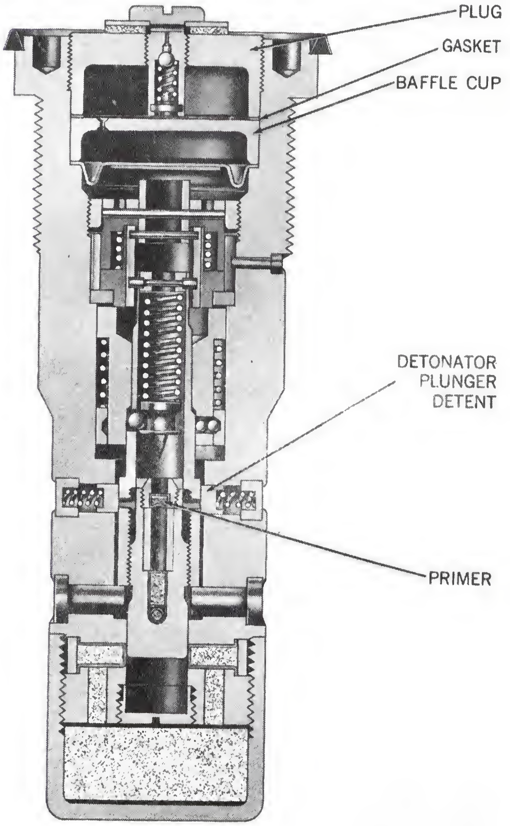


Figure 4-18. Base Fuze Mk 166 Mod 2, Unarmed Position, Cross Section.

2. The Mod 2 has improved gas sealing. A soft copper gasket is added between the plug and the baffle cup. The threads of the plug are luted with silicone grease.

3. The Mod 2 detonator plunger detent is moved rearward slightly to make its functioning more reliable.

This fuze fires when deceleration of the rocket has reached a level of about 75 g. This corresponds to a distance of approximately 180 feet of unobstructed underwater travel when the velocity at which the rocket strikes the water is 1700 fps.

Chapter 5

ROCKET ASSEMBLIES

5-1 2.75-INCH FOLDING-FIN AIRCRAFT ROCKETS

The following paragraphs discuss all 2.75-inch FFAR assemblies. Table 5-1 gives the assembled round by mark and mod numbers with respective he fuze, motor inert parts, igniter, and propellant by mark and mod number

Table 5-1. 2.75-Inch FFAR Assemblies

Use	Round Mk-Mod	Motor and Components				Head Mk-Mod	Fuze Mk-Mod	Prefix	
		Motor Mk-Mod	Inert Parts Mk-Mod	Igniter Mk-Mod	Propellant Mk-Mod			Head	Motor
A-A[1]	2-0	1-3	1-1	125-2	31-1	1-1	176-0	RHHA	RMHA
A-A	2-0	1-4	1-4	125-2	31-1	1-3	176-1	RHHA	RMHA
A-A	2-0	1-4	1-4	125-2	31-1	1-4	176-1	RHHA	RMHA
A-A	2-0	1-4	1-4	125-2	31-1	1-5	176-1	RHHA	RMHA
A-G[2]	2-1	1-3	1-1	125-2	31-1	1-1	178-0	RHHA	RMHA
A-G	2-1	1-4	1-4	125-2	31-1	1-3	178-1	RHHA	RMHA
A-G	2-1	1-4	1-4	125-2	31-1	1-4	178-2	RHHA	RMHA
A-G	2-1	1-4	1-4	125-2	31-1	1-5	178-2	RHHA	RMHA
A-G	3-0	1-3	1-1	125-2	31-1	5-0	181-1	RHHC	RMHA
A-G	3-0	1-4	1-4	125-2	31-1	5-0	181-1	RHHC	RMHA
A-A	4-0	2-0	1-1	125-2,4	43-0	1-1	176-0	RHHA	RMHA
A-A	4-0	2-1	1-1	125-2,4	43-1	1-3	176-1	RHHA	RMHA
A-A	4-0	2-2	1-4	125-2,4	43-0	1-4	176-1	RHHA	RMHA
A-A	4-0	2-3	1-4	125-2,4	43-1	1-5	176-1	RHHA	RMHA
A-G	4-1	2-0	1-1	125-2,4	43-0	1-1	178-0	RHHA	RMHA
A-G	4-1	2-1	1-1	125-2,4	43-1	1-3	178-1	RHHA	RMHA
A-G	4-1	2-2	1-4	125-2,4	43-0	1-4	178-2	RHHA	RMHA
A-G	4-1	2-3	1-4	125-2,4	43-1	1-5	178-2	RHHA	RMHA
A-G	5-0	2-0	1-1	125-2,4	43-0	5-0	181-1	RHHC	RMHA
A-G	5-0	2-1	1-1	125-2,4	43-1	5-0	181-1	RHHC	RMHA
A-G	5-0	2-2	1-4	125-2,4	43-0	5-0	181-1	RHHC	RMHA
A-G	5-0	2-3	1-4	125-2,4	43-1	5-0	181-1	RHHC	RMHA
A-A	6-0	3-0	1-1	125-4	43-0	1-1	176-0	RHHA	RMHA
A-A	6-0	3-1	1-1	125-4	43-1	1-3	176-1	RHHA	RMHA
A-A	6-0	3-2	1-4	125-4	43-0	1-4	176-1	RHHA	RMHA
A-A	6-0	3-3	1-4	125-4	43-1	1-5	176-1	RHHA	RMHA
A-G	6-1	3-0	1-1	125-4	43-0	1-1	178-0	RHHA	RMHA
A-G	6-1	3-1	1-1	125-4	43-1	1-3	178-1	RHHA	RMHA
A-G	6-1	3-2	1-4	125-4	43-0	1-4	178-2	RHHA	RMHA
A-G	6-1	3-3	1-4	125-4	43-1	1-5	178-2	RHHA	RMHA
A-G	7-0	3-0	1-1	125-4	43-0	5-0	181-0	RHHC	RMHA
A-G	7-0	3-1	1-1	125-4	43-1	5-0	181-0	RHHC	RMHA
A-G	7-0	3-2	1-4	125-4	43-0	5-0	181-0	RHHC	RMHA
A-G	7-0	3-3	1-4	125-4	43-1	5-0	181-0	RHHC	RMHA

[1] Air-to-Air
[2] Air-to-Ground

Table 5-1. (Contd.)

Use	Round Mk-Mod	Motor and Components				Head Mk-Mod	Fuze Mk-Mod	Prefix	
		Motor Mk-Mod	Inert Parts Mk-Mod	Igniter Mk-Mod	Propellant Mk-Mod			Head	Motor
A-A	8-0	4-0	1-1	125-4	43-0	1-1	176-0	RHHA	RMHA
A-A	8-0	4-1	1-4	125-4	43-0	1-3	176-1	RHHA	RMHA
A-A	8-0	4-2	1-5	125-4	43-0	1-4	176-1	RHHA	RMHA
A-A	8-0	4-3	1-6	125-4	43-0	1-5	176-1	RHHA	RMHA
A-A	8-0	4-4	1-1	125-4	43-1	1-5	176-1	RHHA	RMHA
A-A	8-0	4-5	1-4	125-4	43-1	1-5	176-1	RHHA	RMHA
A-A	8-0	4-6	1-5	125-4	43-1	1-5	176-1	RHHA	RMHA
A-A	8-0	4-7	1-6	125-4	43-1	1-5	176-1	RHHA	RMHA
A-A	8-0	4-8	1-7	125-4	43-1	1-5	176-1	RHHA	RMHA
A-G	8-1	4-0	1-1	125-4	43-0	1-1	178-0	RHHA	RMHA
A-G	8-1	4-1	1-4	125-4	43-0	1-3	178-1	RHHA	RMHA
A-G	8-1	4-2	1-5	125-4	43-0	1-4	178-2	RHHA	RMHA
A-G	8-1	4-3	1-6	125-4	43-0	1-5	178-2	RHHA	RMHA
A-G	8-1	4-4	1-1	125-4	43-1	1-5	178-2	RHHA	RMHA
A-G	8-1	4-5	1-4	125-4	43-1	1-5	178-2	RHHA	RMHA
A-G	8-1	4-6	1-5	125-4	43-1	1-5	178-2	RHHA	RMHA
A-G	8-1	4-7	1-6	125-4	43-1	1-5	178-2	RHHA	RMHA
A-G	8-1	4-8	1-7	125-4	43-1	1-5	178-2	RHHA	RMHA
A-G	9-0	4-0	1-1	125-4	43-0	5-0	181-0	RHHA	RMHA
A-G	9-0	4-1	1-4	125-4	43-0	5-0	181-0	RHHA	RMHA
A-G	9-0	4-2	1-5	125-4	43-0	5-0	181-0	RHHA	RMHA
A-G	9-0	4-3	1-6	125-4	43-0	5-0	181-0	RHHA	RMHA
A-G	9-0	4-4	1-1	125-4	43-1	5-0	181-0	RHHA	RMHA
A-G	9-0	4-5	1-4	125-4	43-1	5-0	181-0	RHHA	RMHA
A-G	9-0	4-6	1-5	125-4	43-1	5-0	181-0	RHHA	RMHA
A-G	9-0	4-7	1-6	125-4	43-1	5-0	181-0	RHHA	RMHA
A-G	9-0	4-8	1-7	125-4	43-1	5-0	181-0	RHHA	RMHA
A-G	13-0	40-1	......	125-4	43-0	1-1	178-0	RHHA	RMHA
A-G	13-0	40-1	......	125-4	43-1	1-2	178-1	RHHA	RMHA
A-G	13-0	40-1	......	125-4	43-1	1-3	178-2	RHHA	RMHA
A-G	13-0	40-1	......	125-4	43-1	1-4	178-2	RHHA	RMHA
A-G	13-0	40-1	......	125-4	43-1	1-5	178-2	RHHA	RMHA
A-G	14-0	40-0	......	125-4	43-0	5-0	181-0	RHHA	RMHA
A-G	14-0	40-0	......	125-4	43-1	5-0	181-0	RHHA	RMHA

5-1.1 2.75-INCH ASSEMBLED ROUND MK-MOD 3-0, 5-0, 7-0, 9-0, AND 14-0. The 2.75-inch rocket in this configuration, figure 5-1, is used against a variety of targets, including light armor and lightly fortified targets which are to be penetrated by a jet of high-temperature gases from its shaped-charge head.

Lot No. Prefix	RTCD
Nominal Weight (lb)	17.92
Overall Length (in.)	47.93
Warhead Type	HEAT, shaped charge
Burnt Velocity (fps)	2300
Time to 1000 yd (sec)	2.2
Trajectory Table in OP No.	1998
Nose Plug Drawing No.	456924

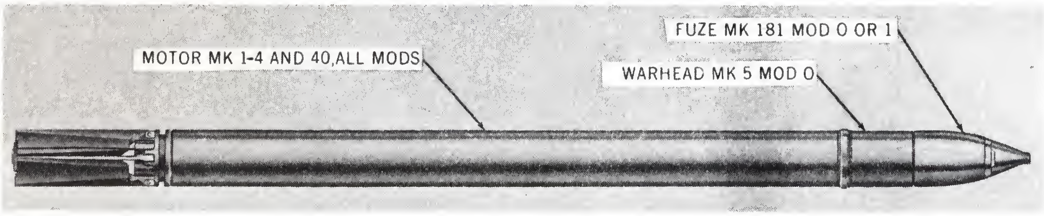


Figure 5-1. 2.75-Inch Rocket Mk-Mod 3-0, 5-0, 7-0, 9-0, or 14-0, Ready for Firing.

5-1.2 2.75-INCH ASSEMBLED ROUND MK-MOD 2-0, 4-0, 6-0, AND 8-0. This configuration is shown in figure 5-2. The Nose Fuze Mk 176 has a delay element.

5-1.3 2.75-INCH ASSEMBLED ROUND MK-MOD 2-1, 4-1, 6-1, 8-1, AND 13-0. This configuration is shown in figure 5-3. The Nose Fuze Mk 178 fires instantaneously. The 2.75-Inch LS FFAR Mk 13-0 is modified to spin slowly to reduce dispersion during helicopter firings.

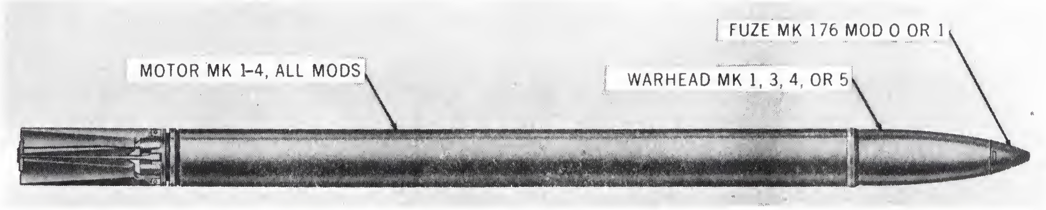


Figure 5-2. 2.75-Inch Rocket Mk-Mod 2-0, 4-0, 6-0, or 8-0, Ready for Firing.

Lot No. Prefix	RTCB
Nominal Weight (lb)	17.92
Overall Length (in.)	47.85
Warhead Type	High explosive blast
Burnt Velocity (fps)	2300
Time to 1000 yd at 70° F. (sec)	2.2
C G From Nose Before Burning (in.)	19.50
C G From Nose After Burning (in.)	15.90
Trajectory Table in OP No.	1998
Nose Plug Drawing No.	456924

Lot No. Prefix	RTCA
Nominal Weight (lb)	17.92
Overall Length (in.)	47.85
Warhead Type	High explosive blast
Burnt Velocity (fps)	2300
Time to 1000 yd at 70° F. (sec)	2.2
C G From Nose Before Burning (in.)	19.50
C G From Nose After Burning (in.)	15.90
Trajectory Table in OP No.	1998
Nose Plug Drawing No.	456924

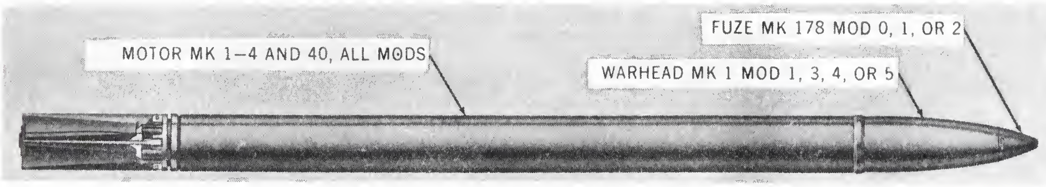


Figure 5-3. 2.75-Inch Rocket Mk-Mod 2-1, 4-1, 6-1, 8-1, or 2.75-Inch Low-Spin Rocket Mk-Mod 13-0, Ready for Firing.

5-2 5.0-INCH HIGH-VELOCITY ROCKETS

Table 5-2 gives the assembled round by mark and mod numbers with respective head, fuze, motor inert parts, igniter, and propellant also by mark and mod numbers.

5-2.1 5.0-INCH ROCKET MK 28 MOD 4 (GP, HVAR) AND MOD 5 (VT, HVAR). These rounds, figure 5-4, are fired from aircraft, primarily against surface targets. With its impact-firing fuzes, the Mod 4 is used against shipping convoys, tanks, and gun emplacements. The Mod 5, which has a VT fuze, is employed against light equipment and personnel.

5-2.2 5.0-INCH ROCKET MK 32 MOD 1 (HEAT, HVAR). This configuration is shown in figure 5-5. With the shaped-charge explosive in the warhead of this round, the rocket is effective against a broad range of surface targets, such as tanks, heavily armored fortifications, and truck convoys. The high-temperature jet of the shaped charge assures deep penetration of armor, while the large number of fragments causes widespread damage to lighter targets.

5-2.3 5.0-INCH ROCKET MK 34 MOD 0 (AP/ASW,HVAR). This round, figure 5-6, is designed for use against underwater targets, particularly submarines.

Table 5-2. 5.0-Inch High-Velocity Rocket Assemblies

Use	Round Mk-Mod	Head Mk-Mod	Nose Fuze Mk-Mod	Base Fuze Mk-Mod	Motor Mk-Mod	Igniter Mk-Mod	Propellant Mk-Mod
A-G[1]	28-4	6-1	149-0	164-0	10-6	114-0 or 1	18-0
	28-4	6-1	149-1	164-0	10-6	114-0 or 1	18-0
	28-5	6-4	172-2	164-0	10-6	114-0 or 1	18-0
A-G	32-1	25-1	149-0	none	10-6	114-0 or 1	18-0
	32-1	25-2	149-1	none	10-6	114-0 or 1	18-0
A-U[2]	34-0	29-0	none	none	10-6	114-0 or 1	18-0
A-G	36-0	4-1	149-0	none	10-6	114-0 or 1	18-0
	36-0	4-1	149-1	none	10-6	114-0 or 1	18-0
PRAC	39-0	6-1 (inert warhead)	Dummy	Dummy	10-6	114-0 or 1	18-0

[1] Air-to-Ground
[2] Air-to-Underwater

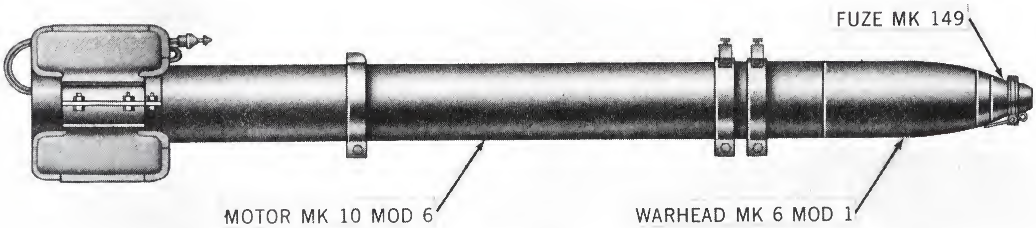


Figure 5-4. 5.0-Inch Rocket Mk 28 Mod 4 (GP, HVAR), External View.

Warhead Type	GP	VT
Mark	28	28
Mod	4	5
General Arrangement	655884	
List of Drawings	174575	
Nominal Velocity (fps)	1325	1325
Nominal Weight (lb)	138.49	138.49
Overall Length (in.)	68.15	69.68
Warhead, 5.0-Inch, Mk-Mod	6-1	6-4
Motor, 5.0-Inch, Mk-Mod	10-6	10-6
Nose Fuze Mk-Mod	149-0 or 1	172-2
Auxiliary Booster Mk-Mod	3-1	None
Base Fuze Mk-Mod	164-0	164-0
Time to 1000 yd (sec) (Temperature at 70° F.)	2.8	2.8
C G Before Burning (in.) (Measured from rear)	34.27	34.27
C G After Burning (in.) (Measured from rear)	35.87	35.87
Trajectory Table in OP No.	1829	1829

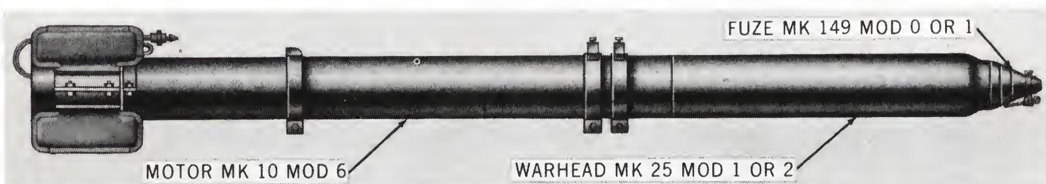


Figure 5-5. 5.0-Inch Rocket Mk 32 Mod 1 (HEAT, HVAR), External View.

Mark	32
Mod	1
Nominal Velocity (fps)	1325
Nominal Weight (lb)	140.47
Overall Length (in.)	84.02
Warhead, 5.0-Inch, Mk-Mod	25-1 or 2
Motor, 5.0-Inch, Mk-Mod	10-6
Nose Fuze Mk-Mod	149-0 or 1
Base Fuze Mk-Mod	None
Time to 1000 yd (sec) (Temperature at 70° F.)	2.8
Trajectory Table in OP No.	1829

Mark	34
Mod	0
Nominal Velocity (fps)	1325
Nominal Weight (lb)	138.43
Overall Length (in.)	64.81
Warhead, 5.0-Inch, Mk-Mod	29-0
Motor, 5.0-Inch, Mk-Mod	10-6
Nose Fuze Mk-Mod	None
Base Fuze Mk-Mod	None (plugge
Time to 1000 yd (sec)	2.8
Trajectory Table in OP No.	1829

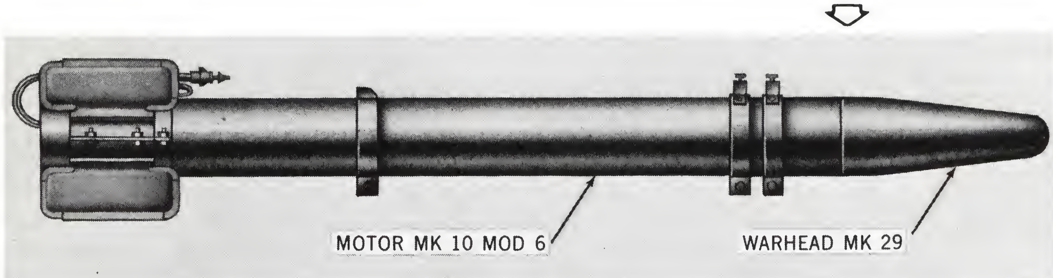


Figure 5-6. 5.0-Inch Rocket Mk 34 Mod 0 (AP/ASW, HVAR), External View.

Figure 5-7. 5.0-Inch Rocket Mk 36 Mod 0 (SMOKE-PWP, HVAR), External View.

Mark	36
Mod	0
Overall Length (in.)	84.98
Nominal Weight (lb)	140.71
Warhead, 5.0-Inch, Mk-Mod	4-1
Motor, 5.0-Inch, Mk-Mod	10-6
Nose Fuze Mk-Mod	149-0 or 1
Base Fuze Mk-Mod	None
Nominal Velocity (fps)	1325
Time to 1000 yd (sec) (Temperature at 70° F.)	2.8
Trajectory Table in OP No.	1829

Mark	39
Mod	0
Overall Length (in.)	68.15
Nominal Weight (lb)	138.37
Warhead, 5.0-Inch, Mk-Mod (Inert Loaded)	6-1
Motor, 5.0-Inch, Mk-Mod	10-6
Dummy Nose Fuze	1211969
Base Fuze Hole Plug	656614
Nominal Velocity (fps)	1325
Time to 1000 yd (sec) (Temperature at 70° F.)	2.8
Trajectory Table in OP No.	1829

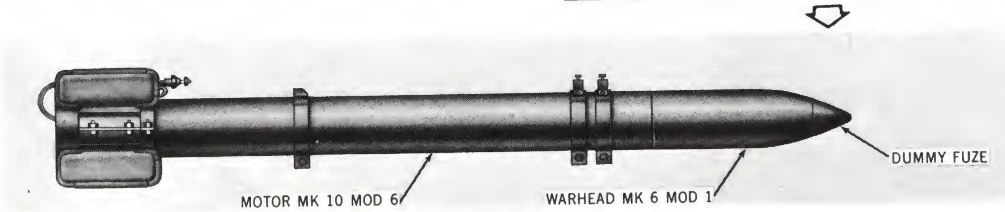


Figure 5-8. 5.0-Inch Rocket Mk 39 Mod 0 (PRAC, HVAR), External View.

5-2.4 5.0-INCH ROCKET MK 36 MOD 0 (SMOKE-PWP, HVAR). This round, figure 5-7, is employed for marking surface targets or for filling holes in a smoke screen.

5-2.5 5.0-INCH ROCKET MK 39 MOD 0 (PRAC, HVAR). This rocket, figure 5-8, is the practice round for 5.0-inch high-velocity aircraft rockets. In the head, a dummy nose fuze and a base fuze hole plug are used to replace the nose fuze and base fuze, respectively.

This rocket is also used as a practice round for the 5.0-Inch Rocket Mk 34 Mod 0 ASW round. When used for low-level ASW practice, the dummy nose fuze is replaced with a flat shipping plug (BuWeps dwg 434040-1) to provide better water entry characteristics.

5-3 5.0-INCH FOLDING-FIN AIRCRAFT ROCKETS

Table 5-3 gives the assembled round by mark and mod numbers with respective head, fuze, motor inert parts, igniter, and propellant also by mark and mod numbers.

5-3.1 5.0-INCH FFAR MK 40 MODS 0 AND 1 (ZUNI). This rocket, figure 5-9, is aircraft-fired primarily against surface targets. The mod numbers are determined by the use of either impact detonating or VT fuzes. The Mod 0 is used against shipping, tanks, and gun emplacements. The Mod 1, equipped with a VT fuze, is employed against light equipment, fortifications, and personnel. These rounds may be ripple- or single-fired from four-round launcher packages.

Table 5-3. 5.0-Inch FFAR Assemblies

Use	Round Mk-Mod	Head Mk-Mod	Nose Fuze Mk-Mod	Base Fuze Mk-Mod	Motor Mk-Mod	Igniter Mk-Mod	Propellant Mk-Mod
A-G [1]	40-0	24-0	M414A1	191-1	16-2	130-1	49-1
A-G	40-1	24-0	188-0	191-1	16-2	130-1	49-1
A-G	40-3	Nose Ogive	none	191-1	16-2	130-1	49-1
A-G	41-0	32-0	M414A1	none	16-2	130-1	49-1
A-G	41-1	32-0	188-0	none	16-2	130-1	49-1

[1] Air-to-Ground

Figure 5-9. 5.0-Inch Rocket Mk 40 Mod 1 (ZUNI), Ready for Firing.

Warhead Type	GP	VT
Mark	40	40
Mod	0	1
Nominal Weight (lb) (approx)	107	107
Overall Length (in.) (approx)	100	100
Warhead Mk-Mod	24-0	24-0
Warhead Type	HE	HE
Motor Mk-Mod	16-1 or 2	16-1 or 2
Nose Fuze Mk-Mod	188-0	M414
Base Fuze Mk-Mod	191-1	191-1
Burnt Velocity (fps)	2370	2370

Warhead Type	GP	VT
Mark	41	41
Mod	0	1
Nominal Weight (lb) (approx)	107	107
Overall Length (in.) (approx)	110	110
Warhead Mk-Mod	32-0	32-0
Warhead Type	ATAP	ATAP
Motor Mk-Mod	16-1 or 2	16-1 or
Nose Fuze Mk-Mod	188-0	M414
Base Fuze Mk-Mod	None	None
Burnt Velocity (fps)	2370	2370

Figure 5-10. 5.0-Inch Rocket Mk 41 Mod 1 (ZUNI), Ready for Firing.

5-3.2 5.0-INCH FFAR MK 41 MODS 0 AND 1 (ZUNI) (ATAP). This configuration is shown in figure 5-10. The shaped-charge explosive in the warhead of this round provides it with unusual tactical flexibility. Fuzed with Point-Detonating Fuze Mk 188, it is effective against a number of surface targets such as tanks, heavily armored fortifications, and vehicles of all types. These rounds may be ripple- or single-fired from four-round launcher packages.

Chapter 6

ASSEMBLY AND DISASSEMBLY OF COMPLETE ROUNDS

6-1 ASSEMBLY AND DISASSEMBLY OF 2.75-INCH FOLDING-FIN AIRCRAFT ROCKETS

The types of 2.75-inch warheads, motors, and fuzes are described in chapters 2, 3, and 4. Complete rocket assemblies are listed in chapter 5. Assembly or disassembly of 2.75-inch FFARs consists of joining or disjoining the warhead, which is issued with the fuze installed, to the motor. Folding-fin rockets generally are distinguished from other rockets by their containers. There are two types of 2.75-inch rocket motors—undimpled and dimpled. All new rocket motors have been dimpled before issue and some motors have been reworked, but until all are dimpled, two different procedures are to be followed. The following tools are required: spanner wrench or soft-jaw vise, and a modified torque wrench.

6-1.1 UNDIMPLED MOTORS AND WARHEADS. When rockets are shipped in the 4-round Container Mk 1, figure 1-20, the nose end of the fuzed warhead is seated in a head shipping support in the forward end of the rocket motor. Assemble these rounds as follows:

1. Remove warhead and head shipping support from motor. The shipping support is snap-fitted to the head closure in the motor.

2. On some motors, there is a rubber gasket ring under the lip of the head shipping support and a sh between the head shipping support and the head closure. Remove and dispose of shim and gasket before threading warhead to motor.

3. Hold motor tube at forward end with spanner wrench or soft-jaw vise that will not mark or deform the tube. Figure 6-1 shows a wrench

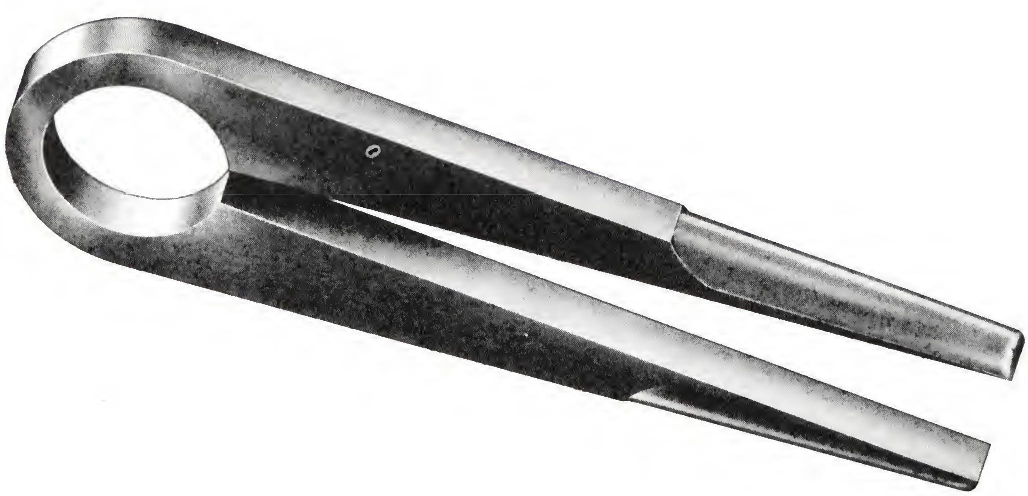


Figure 6-1. 2.75-Inch Rocket Spanner Wrench.

used to grip the motor tube and facilitate assembly. The motor is to be held within the forward 2 1/2 inches in order to be in the area supported by the head closure assembly.

> CAUTION: Do not pull the lockwire tab down and out of the elongated hole into the motor tube lockwire groove. The enlarged tab traveling through the lockwire groove will bulge the motor tube, making it unsafe to fire. Any motors with the lockwire tab displaced either by turning in or out of the elongated groove should be discarded as unserviceable. If a gap exists between the forward end of the motor and the warhead after assembly, discard the rocket as unserviceable.

4. Using another wrench on the warhead or a wrench on the fuze, tighten warhead as tightly as possible without causing head closure to turn and force lockwire in or out of elongated hole in motor tube lockwire groove. Movement of this tab within the confines of the elongated hole is normal. Figure 6-2 shows the motor tube and lockwire slot.

5. Inspect rockets for marks, scores, abrasions, deformation of motor tube, or gap between head and motor. Discard as unserviceable any rockets with evidence of these defects.

> CAUTION: The fin protector contains a spring that serves to short-circuit the igniter leads.

6. Do not remove fin protector until just before loading the round in the launcher.

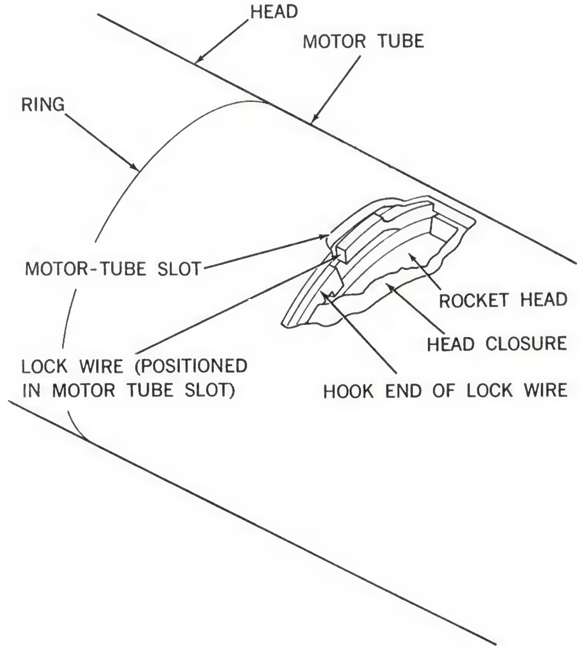


Figure 6-2. 2.75-Inch Rocket Motor Tube Lockwire Slot, Cutaway View.

Motors shipped in the shipper-launcher package must be removed partially from the launcher. If difficulty is encountered in removing the rocket motor, do not use the launcher. Some launcher detents may stick, and excessive torque applied to the rocket to cam the detent may damage the detent or turn in the lockwire in the nozzle end of the motor.

All rockets returned from a flight also will be tightened as described in the preceding steps, prior to the next flight.

Further assembly is given in chapter 7.

6-1.2 DIMPLED MOTORS AND WARHEADS. The assembly procedure for this configuration of rocket motor is the same as that given in paragraph 6-1.1, except for the method of tightening the rocket warhead which is as follows:

1. Using another strap wrench on the fuze or a fuze wrench, tighten warhead as much as possible without turning head closure, which would deform the motor tube dimples or force the lockwire into or out of the elongated hole in the tube.

NOTE: Motor tubes whose dimples have been straightened inadvertently may be used if the lockwire tab has not been forced into or out of the elongated hole in the motor tube, and if examination shows no cracks or other motor tube damage.

2. Using a modified torque wrench, figure 6-3, apply 55 foot-pounds of torque to tighten the warhead. Properly dimpled motors will resist 80 foot-pound torques.

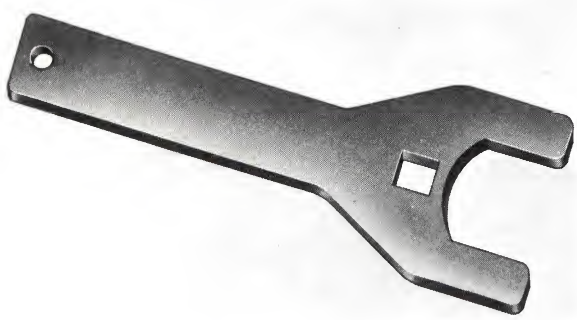


Figure 6-3. Modified Torque Wrench.

NOTE: This wrench may be fabricated locally. To modify the wrench (dwg 652809), cut 1/2 by 1/2-inch square hole to accept 1/2-inch drive torque wrench.

CAUTION: If a gap exists between the forward end of the motor and the warhead after assembly, discard the rocket as unserviceable.

3. Inspect rockets for marks, score abrasions, deformation of motor tube, or gap between warhead and motor. Discard as unserviceable any rocket with these defects.

CAUTION: The fin protector contains a spring that serves to short-circuit the igniter leads. Check to see that it is in place.

4. Do not remove the fin protector until just before loading the round in the launcher.

6-1.3 ROCKET MOTORS IN AERO 6A LAUNCHER PACKAGE. Seven rocket motors are issued in the Aero 6A aircraft launcher package. No head shipping support is included because the warheads are issued in a separate container (see figure 1-19). Normally, it is not necessary to remove motors from the shipper-launcher container to assemble the warheads. If it is necessary to partially remove the motor from the shipper-launcher, screw the warhead onto the motor and pull forward. The clockwise twisting will cause a lug on a fin hinge to engage a low angle cam on the side of the detent in the shipper-launcher tube. The cam drives the detent to the side and releases the rocket. If difficulty is encountered in removing the rockets from the launchers, another Aero 6A launcher should be used. Some launcher detents may stick, and excessive torque applied to the rocket to cam the detent up may damage the detent or turn the lockwire in the nozzle end of the motor.

After assembling the warhead as described in paragraph 6-1.1 or 6-1.2 as applicable, proceed as follows:

1. Replace rocket in shipper-launcher tube.

2. Make certain that fins straddle detent in tube before pushing motor into the shipper-launcher tube.

> NOTE: If a fin is not on either side of the detent, the motor may slide past the detent and damage the ignition system.

3. Push rocket into tube with firm pressure until detent snaps into groove on the nozzle plate.

4. Pull forward on motor to make certain that the detent is properly latched. The detent should hold the motor firmly.

Rocket motors and warheads received in other containers may be assembled and loaded in the Aero 6A launcher package. In this case, the warheads may be assembled to the motors before being placed in the shipper-launcher or they may be assembled after the motors are positioned in the shipper-launcher. Fin protectors and head shipping supports must be removed from motors received in other containers before they are loaded into this type of launcher.

More details on the assembly of rockets in Aero 6A launchers are given in chapter 7.

6-1.4 ROCKETS IN AERO 7D AIRCRAFT ROCKET LAUNCHER. Nineteen complete rocket assemblies are shipped and launched in the Aero 7D aircraft rocket launcher package. It has been reported that when rockets are shipped in this shipper-launcher the detents have become unlatched. Before use, an inspection is necessary, as follows:

> CAUTION: This check should not be made by hand if launcher is on the aircraft or in a RADHAZ environment. Check below deck if practicable. If it becomes necessary to check on flight deck, observe provisions of BuShips Message 232230Z May 1958. Use a nonconductive plastic rod 12 inches or more in length to push rockets.

1. Remove the launcher package end pans and RADHAZ barriers and push forward, gently but firmly, on the fin retainer of each rocket. If the rocket moves forward when pushed, its detent is unlatched.

2. To relatch the detent, push aft, gently but firmly, on the rocket warhead until the detent snaps into the rocket detent groove.

3. Retest to see that the detent holds.

6-1.5 DISASSEMBLY. The disassembly of the 2.75-inch rocket is as follows:

1. Install fin protector over aft end of motor and fins.

2. Unscrew warhead from motor BY HAND.

3. DO NOT remove fuze from warhead. Lightly grease the threads of warhead to prevent corrosion and return warhead to stowage.

4. Install head shipping support in head closure of motor, if supplied, and return motor to stowage.

6-2 ASSEMBLY AND DISASSEMBLY OF 5.0-INCH HIGH VELOCITY AIRCRAFT ROCKETS

The tools, procedures, and precautions to be used in assembly and disassembly of the 5.0-inch HVAR are discussed in the following paragraphs.

6-2.1 TOOLS. The following tools are required for assembly and disassembly of the 5.0-inch HVAR:

6-2.1.1 5.0-Inch Utility Spanner Wrench. A steel wrench (BuOrd dwg

592882-A), figure 6-4, is used on 5.0-inch heads and on the 5.0-inch head and motor shipping caps which are recessed to receive the pin of the wrench. The rectangular hole in the handle of the wrench fits the flats of nose shipping plugs.

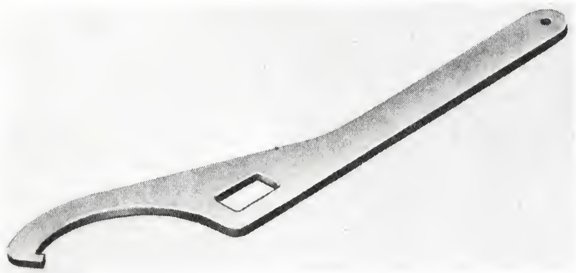


Figure 6-4. 5.0-Inch Utility Spanner Wrench.

6-2.1.2 Fuze Wrenches. A steel fuze wrench (BuOrd SK 124784), figure 6-5, fits the flats on the ogive of Nose Fuze Mk 149 all Mods. Fuze wrench M-17 (Army dwg 73-3B1-1), figure 6-6, fits the lugs on the body of VT Fuze Mk 172 all Mods.

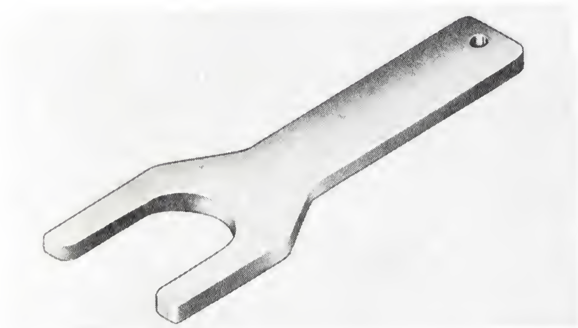


Figure 6-5. Fuze Wrench (BuOrd SK 124784).

Figure 6-6. Fuze Wrench M-17.

6-2.2 ASSEMBLY PROCEDURES. To assemble the components of the 5.0-inch HVAR, proceed as follows:

1. Remove rocket motor from container and slip a slotted cork (FSN-1340-038-9290) protector over the wire of the electrical connector with the small diameter of the cork protector facing the motor nozzle. This is required to prevent electrical connectors from rubbing against the edges of rocket motors and motor nozzle edges and buffeting because of excess slack.

2. Place motor in clamps or assembly rack. If spanner wrench is used, locate it a few inches behind forward end of motor.

3. Position and secure suspension bands to fit the launcher which is to be used to fire the round. Suspension bands are moved by loosening or tightening the bolts which clamp the bands to the motor tube.

4. Slip fin assembly over nozzle en of motor tube so that it interlocks wi projections on rear lug supporting band.

5. Secure fin assembly by tightenin bolts into nuts which are brazed to fi assembly sleeve.

6. Remove shipping cap from forward end of motor tube. Do not remove felt washer that is located forward of front closure disc.

7. Remove shipping cap from base of rocket warhead.

8. Inspect to ensure that a base fuze, gas-checked, or a base fuze ho plug, gas-checked, has been installe properly if Warhead Mk 29 (AP/ASW is to be used.

9. Screw warhead into motor, usin the 5.0-inch utility spanner wrench (see figure 6-4) to set warhead.

10. Remove rear shipping cap from motor.

CAUTION: Do not remove the shorting clip on the electrical connector plug at this time.

11. Remove shipping plug from nose of warhead. Make certain that auxiliary booster does not fall out.

12. Install nose fuze. If Nose Fuze Mk 149 is used, insert and seat it. Tighten it, using fuze wrench, figure 6-5. If Nose Fuze Mk 172 is used, proceed as follows:

a. Pull out rear safety pin; then reinsert it. If the pin does not insert easily, pull pin out again.

b. Insert fuze in cavity and screw the threads into warhead tightly, using Fuze Wrench M-17, figure 6-6.

13. Remove assembled rocket from clamps or assembly rack.

14. After the Mk 172-fuzed rocket is loaded in the launcher, install arming wire in Mk 172 fuze as follows:

a. Remove seal wire.

b. Insert arming wire in hole where seal wire was located, inboard hole of arming pin.

NOTE: It may be necessary to move the arming pin to another hole in the ring in order to line up the arming pin with the arming wire. In moving the arming pin to another hole, take care to avoid turning the arming vanes. The end of the arming wire should extend 3 to 4 inches beyond the forward end of the fuze.

CAUTION: DO NOT USE FAHNESTOCK CLIPS. They might foul the arming vanes. Sufficient tension is provided by the arming pin spring to hold the arming wire securely in place.

c. Remove cotter pin after arming wire has been installed properly.

15. After the rocket has been installed in the aircraft rocket launcher and the electrical connector plugged into its receptacle on the aircraft, take out excess slack by looping the wire of the electrical connector and passing the loop through slotted portion of the cork protector.

16. Then force the cork protector into the rocket motor nozzle, causing the slot to close firmly over the electrical connector wire.

6-2.3 DISASSEMBLY PROCEDURES. To disassemble the components of the 5.0-inch HVAR, proceed as follows:

1. Be sure that the shorting clip is in place on electrical connector plug and that safety wire is in place on fuze.

2. Place rocket in clamps or assembly rack.

3. Unscrew nose fuze with proper fuze wrench. Make certain that auxiliary booster does not fall out.

4. If Nose Fuze Mk 172 was used, make the test with the rear safety pin as given in paragraph 6-2.2, step 12(a). Return fuze to the container and reseal the container.

5. Screw shipping plug into nose of warhead.

6. Unscrew warhead from motor, using 5.0-inch utility spanner wrench.

7. Check base fuze to see that it is secure; then screw rear shipping cap on warhead.

8. Return warhead to its container.

9. Replace rear shipping cap on motor.

10. Be sure that felt washer is in place on forward end of motor; then screw on shipping cap.

11. Loosen bolts that secure fin assembly sleeve to motor tube.

12. Slide fin assembly off of nozzle end of motor tube.

13. Inspect fin assembly for bends or other damage. If none present, or after repairs are made, return fin assembly to its container.

14. Tape electrical connector to motor tube.

15. Return motor to its container, being careful not to place any strain on electrical connector cable or plug.

6-3 ASSEMBLY AND DISASSEMBLY OF 5.0-INCH FOLDING-FIN AIRCRAFT ROCKET (ZUNI)

The types of heads, motors, and fuzes for the 5.0-inch FFAR (ZUNI) are described in chapters 2, 3, and 4. Complete assemblies are listed in chapter 5.

The Mk 16 motors are shipped completely assembled in the LAU-10/A launcher or in individual metal or wooden shipping containers. The heads are shipped in individual wooden boxes—one or two to a box. The fuzes are shipped in containers—32 to a container, except the Mk 191 base fuze which is permanently installed in the Mk 24 head when received. Six frangible fairings, enough for three launchers, are shipped in a separate container. The type of head or fuze to be assembled to the motor in the launcher depends on the mission.

The ZUNI rocket warhead is installed on the motor after the launcher is mounted to the aircraft; fuzes (unlike 2.75-inch FFAR fuzes) are not shipped assembled to the rocket heads but are attached as part of the pre-takeoff armament procedure. The assembly of ZUNI components and t[he] special tools required are given in the following paragraphs.

6-3.1 TOOLS. A detent-lift tool, figure 6-7, and an ignition post, figu[re] 6-8, are shipped with the launcher. These tools are used in mounting th[e] launcher to the aircraft and are discussed in more detail in paragraphs 7-6.4 and 7-6.5. A special chain wrench, figure 6-9, is used to attach the warhead to the motor.

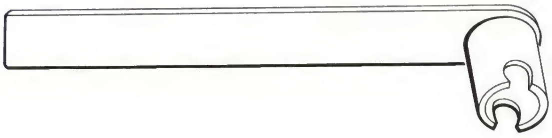


Figure 6-7. Detent-Lift Tool.

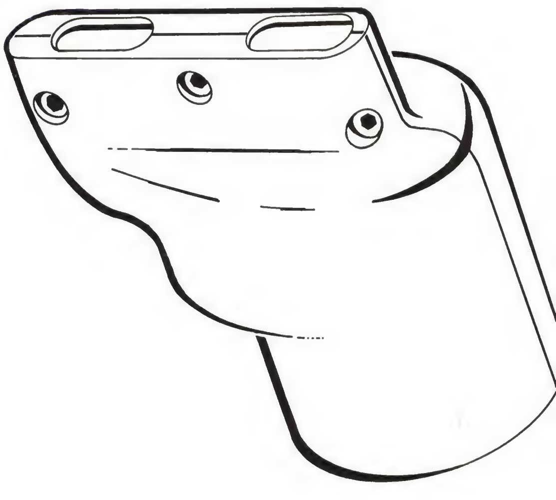


Figure 6-8. Ignition Post.

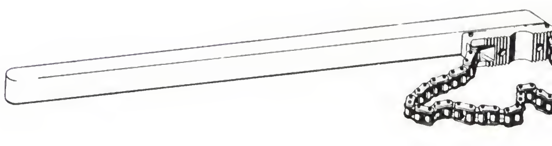


Figure 6-9. Chain Wrench for Attaching Warhead to Motor.

6-3.2 ASSEMBLING WARHEAD AND FUZE TO MOTOR. The appropriate warhead and fuze are attached to the motor after the shipper-launcher (LAU-10/A) is mounted on the aircraft. Procedures are as follows:

WARNING

No attempt should be made to remove the base fuze except by qualified bomb-disposal personnel. The Mk 191 base fuze and gas check gasket are used with every live loaded head. If base fuze hole is uncovered or has any other plug or cover, the head shall not be used, but will be returned to the nearest NAD. Base fuze hole in Mk 24 Mod 0 plaster filled PRACTICE head must be plugged with Base Fuze Hole Plug, Piece No. 457600. This piece is indent stamped "FOR INERT LOADED HEADS ONLY." If this piece is not in place, Mk 24 head will NOT be used, but will be returned to nearest NAD. Failure to comply with these directions can result in premature detonation of the head with attendant loss of life and materiel.

1. Screw rocket warhead into rocket motor and tighten securely with chain wrench (see figure 6-9) (approximately 100 foot-pounds torque).

2. Attach appropriate nose fuze and tighten with spanner wrench (torque wrench) to 40 foot-pounds of torque.

NOTE: The rocket stop in the aft end of the launcher prevents the motors from turning while heads and fuzes are being screwed in place.

Complete details of assembly are given in paragraphs 7-6.4 and 7-6.5.

6-3.3 DISASSEMBLY OF WARHEAD AND FUZE FROM MOTOR. If unfired rockets are to be disassembled, remove fuze and warhead in reverse of procedures given in paragraph 6-3.2.

Chapter 7

AIRCRAFT ROCKET LAUNCHER PACKAGES

7-1 GENERAL INFORMATION

Aircraft rocket launcher packages are aluminum or fiberboard cylinders containing horizontally nested aluminum or paper tubes. They are used exclusively for FFARs (e. g., 2.75-inch Mighty Mouse and 5.0-inch ZUNI), the design of which permits multiple loading and launching. Aircraft rocket launcher packages such as Aero 6A series and LAU-10/A provide a means by which rocket motors are shipped and stowed and used for final firing. Other rocket launcher packages such as Aero 7D, LAU-3/A, LAU-3A/A, LAU-32A/A provide a means by which completely assembled rounds may use the same containers from manufacture, through stowage, to final firing. Aircraft Rocket Launcher Aero 1A is a single-tube metal launcher used to fire the 2.75-inch FFARs. The LAU-33/A and 35/A are launchers which can be used on guided missile launchers.

Shipper-launcher packages have frangible fairings which are attached to both ends of the launcher to provide low-drag aerodynamic characteristics during flight. These fairin are disintegrated by rocket blast an by the forward movement of the rockets.

In most cases, launcher packages are jettisoned after firing or at the pilot's discretion. On training missions, however, configurations o launchers that have a service life of a number of ripple firings should not be jettisoned except in emergencies.

This chapter provides instruction for operation and maintenance of 15 rocket launcher package configurations. Table 7-1 lists these launche

At the time of this publication, the LAU-49/A, LAU-50/A, and LAU-51 rocket launcher packages are relatively new. As a result, these launchers are subject to further mo fication, and operating specification have not been released as yet.

TABLE 7-1. LAUNCHERS

Launcher Ident	Type	Rockets Ident	No. of Rounds
Aero 1A	reusable launcher	2.75-in. FFAR	1
Aero 6A	expendable motor shipper-launcher	2.75-in. FFAR	7
Aero 6A1	expendable motor-shipper-launcher	2.75-in. FFAR	7
Aero 6A2	expendable motor-shipper-launcher	2.75-in. FFAR	7
Aero 7D	expendable complete round shipper-launcher	2.75-in. FFAR	19
LAU-3/A	expendable complete round shipper-launcher	2.75-in. FFAR	19
LAU-3A/A	expendable complete round shipper-launcher	2.75-in. FFAR	19
LAU-10/A	reusable motor-shipper-launcher	5.0-in. ZUNI	4
LAU-32A/A	expendable complete round shipper-launcher	2.75-in. FFAR	7
LAU-32B/A	reusable complete round shipper-launcher	2.75-in. FFAR	7
LAU-33/A	reusable launcher	5.0-in. ZUNI	2*
LAU-35/A	reusable launcher	5.0-in. ZUNI	2*
LAU-49/A	complete round shipper-launcher	2.75-in. FFAR	7
LAU-50/A	complete round shipper-launcher	2.75-in. FFAR	19
LAU-51/A	reusable complete round shipper-launcher	2.75-in. FFAR	19

* These launchers are used with the Aero 3A or LAU-7/A guided missile launcher. The total number of rounds depends on the loading. Mixed loads of guided missiles and rockets are possible.

7-2 AERO 1A AIRCRAFT ROCKET LAUNCHER

The Aero 1A aircraft rocket launcher is a reusable single tube, metal launcher for the 2.75-inch FFAR. It fits on the Aero 14 and 15 series bomb racks only. It is RADHAZ dangerous and not permitted aboard ship. However, it can be used on land-based aircraft. Procedures for preparing the rocket and launcher are given in paragraphs 6-1.1 through 6-1.4; disassembly procedures are given in paragraph 6-1.5.

7-3 AERO 6A SERIES AIRCRAFT ROCKET LAUNCHER PACKAGES

The Aero 6A, 6A1, and 6A2 launcher packages are expendable dual-purpose stores which house seven 2.75-inch FFAR motors from the time of manufacture until assembled with warheads and fired at the target. As used, these launcher packages are divided into two configurations: a shipping configuration and an airborne, or rocket launcher, configuration.

7-3.1 SHIPPING CONFIGURATION. The shipping configuration, figure 7-1, consists of two packages: the launcher center section fitted with reusable shock-absorbing end pans, seven rocket motors, and rocket motor retaining plugs; and an expendable fiberboard shipping drum containing eight low-drag, frangible fairings. One package of fairings is supplied with every four motor containers.

The launcher center section is made of seven paper tubes surrounded by a heavy fiberboard casing and is capped with metal end-bulkheads. The paper components are encapsulated with a rough plastic material which protects the paper against moisture and the effects of rocket blasts. The metal bulkheads are swaged in place and sealed to the casing. Three internal longitudinal tie rods, with fittings on the end bulkhead, provide attaching means for the shipping end pans.

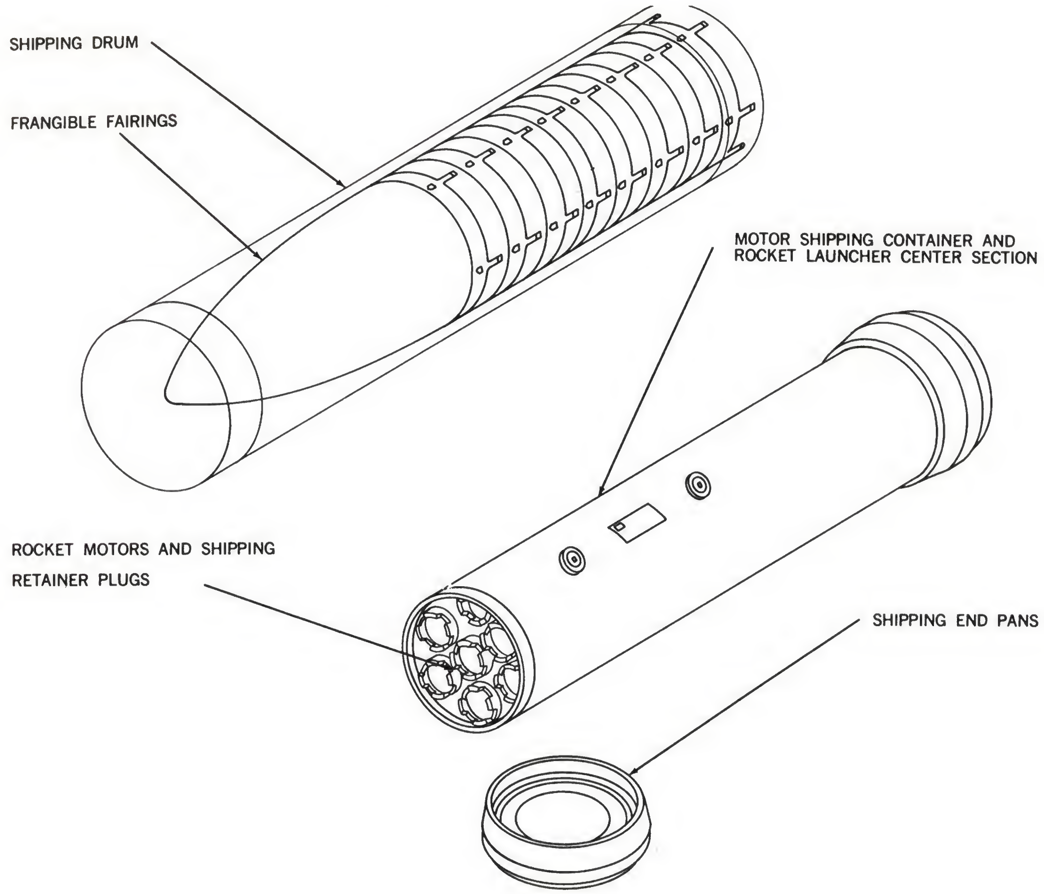


Figure 7-1. Aero 6A Aircraft Rocket Launcher Package, Shipping Configuration.

A leaf-spring blast-operated detent retains the rocket in each launching tube and withstands a thrust load of 15 g. When the rocket is fired, a hot, burning propellant blast from the rocket nozzle impinges on the blast paddle of the detent, causing it to release and allowing the rocket to be launched.

7-3.2 AIRBORNE CONFIGURATION. The launching configuration, figure 7-2, consists of one center section containing seven assembled rockets and equipped with two frangible fairings.

7-3.2.1 Ignition. Electrical power for the rocket ignition system is supplied to the launcher by the aircraft 28-volt DC armament circuits through a jack-plugged ignition cabl The firing impulse is distributed to the rockets by a small molded plast ignition spider, figure 7-3, attached to the aft bulkhead of the launcher center section. The ignition spider has no moving parts and requires n maintenance. Blast from rocket fir severs the ignition cable at the cabl breaker and facilitates jettisoning o the spent launcher.

7-3.2.2 Suspension Provisions. Th launchers are suspended from two suspension hooks which are 14 inch apart and extend from the bomb rac The Aero 6A suspension hangers (s figure 7-2) are too small to accomm date the suspension hooks on all but

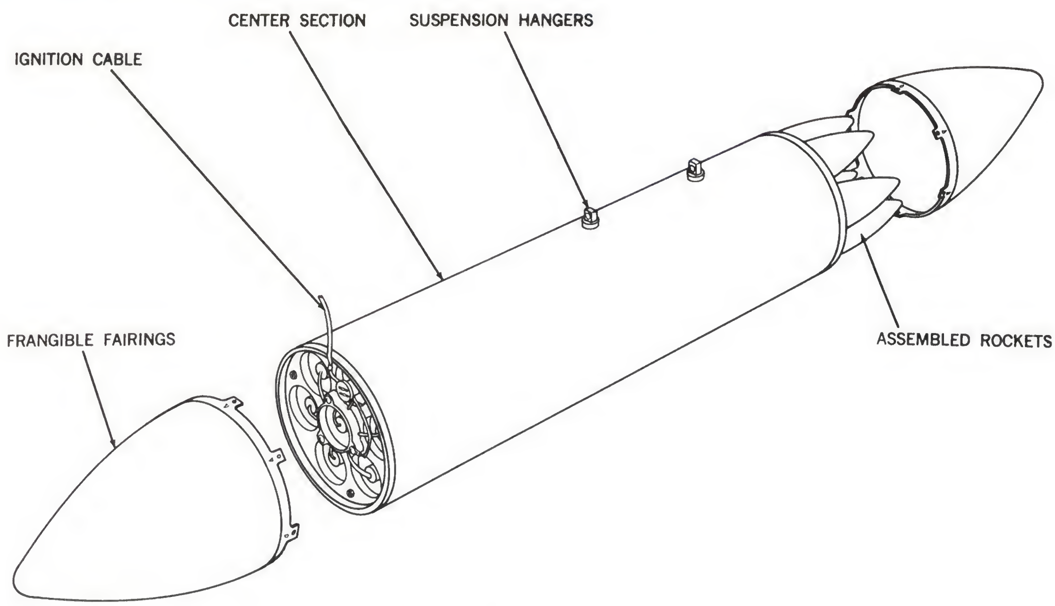


Figure 7-2. Aero 6A Rocket Launcher, Airborne Configuration.

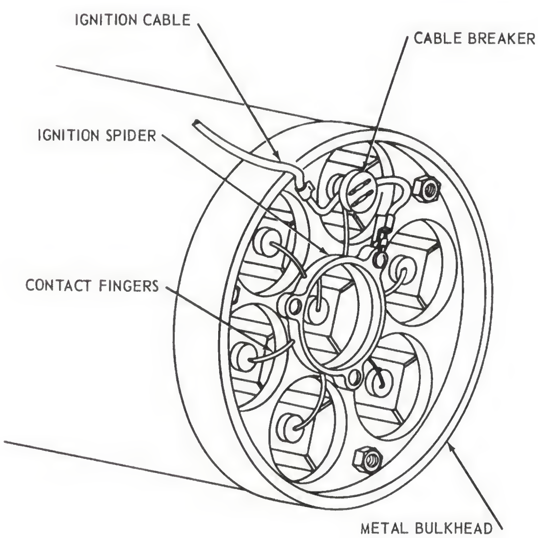


Figure 7-3. Ignition System.

the Aero 14 bomb rack series. In order that the Aero 6A launcher may be adapted to other than the Aero 14 rack series, an eye-nut hanger lug, figure 7-4, has been designed, which is mounted in place of the existing launcher suspension hangers. The eye-nut hanger lug is mounted by removing the hexagonal nut located at the base of the suspension hanger and, using the same threads, screwing the lug in its place. The Aero 6A1 launcher suspension hangers fit all bomb racks. By use of a screwdriver, hangers can be turned counterclockwise until fully extended. The Aero 6A2 launcher is equipped with the eye-nut hanger lug and, therefore, requires no modification. During shipment and stowage, tape covers the hanger wells and the retracted suspension hangers on the Aero 6A and 6A1 launchers.

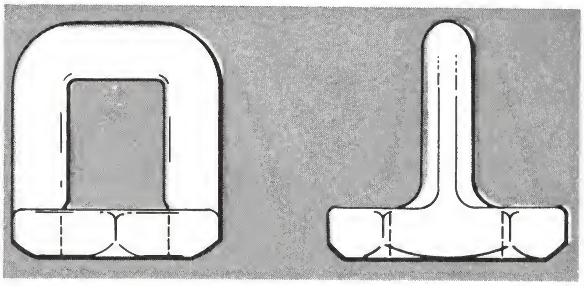


Figure 7-4. Eye-Nut Hanger Lug.

7-3.2.3 Frangible Fairings. The launcher fairings are made of treated pulp and will shatter readily from rocket impact or backblast. A metal band at the base of each fairing slips over the launcher bulkhead to hold the fairing in place.

7-3.2.4 Special Tools. No special tools are used with the Aero 6A series aircraft rocket launcher packages.

7-3.3 TRAINING ROCKET LAUNCHER. A KMU-52/A kit (FSN RD 1055-856-8818B210) may be requisitioned to replace the ignition spider on the Aero 6A series rocket launcher. This kit provides single fire action for Fleet training use. Instructions relative to installation and operation are included with each kit.

7-3.4 AERO 6A SERIES AIRCRAFT ROCKET LAUNCHER PACKAGE SPECIFICATIONS. The following are the specifications for the shipping configuration of the launcher with motors, the fairing container with fairings, and the airborne configuration of the launcher with rockets:

Shipping Configuration, motors:	
Length (in.)	45
Diameter (in.)	10 1/2
Weight (lb)	116
Capacity (rounds)	7
Shipping Configuration, fairings:	
Length (in.)	49
Diameter (in.)	11 1/2
Weight (lb)	19
Capacity (fairings)	8
Airborne Configuration:	
Length With Fairings (in.)	75.1
Length Without Fairings (in.)	41
Diameter (in.)	9.75
Capacity (rockets)	7
Weight, loaded (lb)	148
Weight After Firing (lb)	20.5
Suspension	14-inch racks
Firing Rate	Salvo

7-3.5 PREPARATION FOR USE. When preparing the Aero 6A series launchers for use, follow the procedures outlined in paragraphs 7-3.5.1 through 7-3.5.10.

7-3.5.1 Shipper-Loader. Remove the shipping components from the shipper-loader (launcher center section), figure 7-5, as follows:

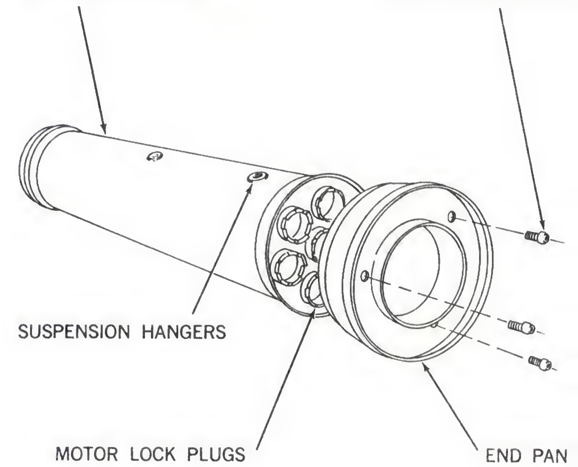


Figure 7-5. Removal of End Pans.

WARNING

Conduct the following steps in a RADHAZ safe area.

1. Remove three attach bolts from each shipping end pan (shock pan) with wrench attached to pan.

NOTE: If tie rod fittings unscrew instead of the attach bolts, reassemble entire rod assembly and tighten rods.

2. Remove end pan assemblies, figure 7-5.

7-3.5.2 Removal of Motors From Shipper-Launchers.

WARNING

Conduct the following steps in a RADHAZ safe area.

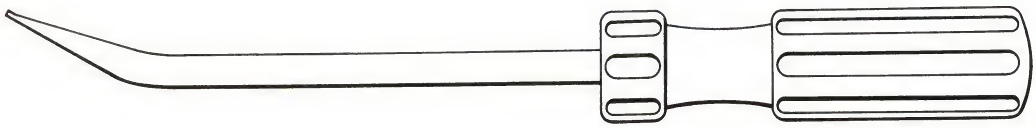


Figure 7-6. Tool for Removing Motors From Aero 6A Launcher.

1. Loosen rocket motor lock plugs 1/2 turns.

2. Place tool, figure 7-6, under flange of motor lock plug of center motor; use the lock plug of another motor as a fulcrum, and pry motor from detent.

3. Unlatch each remaining motor by placing tool under lock plug flange, using tie rod nut as the fulcrum to pry motor from detent.

4. Remove motors from launcher.

7-3.5.3 Alternate Method For Rocket Motor Removal. For an alternate method of removing the rocket motors from the shipper-launchers, proceed as follows:

1. Install rocket head on motor to be withdrawn.

2. Turn motor in the direction to tighten head and at the same time pull forward. As the rocket fin hinge cams the detent open, withdraw the rocket.

7-3.5.4 Installing Rocket Warheads. The procedure is as follows:

WARNING

Conduct this installation in a RADHAZ safe area.

1. Assemble warheads to rocket motors following the procedure outlined in paragraphs 6-1.1 and 6-1.2.

7-3.5.5 Loading Launcher. To load the rockets into the launcher, proceed as follows:

WARNING

Conduct the following steps in a RADHAZ safe area.

1. Align motor with launcher tube and position fins so they straddle detent.

2. Slide rocket into launcher tube with firm pressure until detent snaps into place.

3. Make sure detent is properly latched in groove of motor by pulling forward on motor.

7-3.5.6 Checking Ignition Spider. With rockets loaded in the launcher, check the ignition spider contact fingers for proper contact as follows:

1. If any finger does not contact the rocket ignition button, remove rocket and carefully bend finger into the launcher tube (see figure 7-3).

CAUTION: Bending the fingers carelessly or too far could damage the ignition spider.

2. Reinstall rocket.

7-3.5.7 Testing Aircraft Armament Circuit. This test need not be conducted for each Aero 6A series loading, but should be done in conjunction with the aircraft preflight check. The armament circuit must function properly to ensure accurate, dependable, and safe launching of the rockets.

NOTE: The greatest single cause of firing failure is insufficient electrical power at the plug-in receptacles.

Proceed as follows:

1. Increase engine rpm until cockpit voltmeter indicates full system voltage.

2. Plug an ammeter, 0 to 10-ampere range, directly into rocket firing receptacle of bomb rack.

3. Have plane captain "pickle" the station where the ammeter is plugged in, and observe the reading. (The ammeter should register more than 4.5 amperes.)

NOTE: A pulse less than 4.5 amperes may not fire the entire rocket load.

4. Place armament switches in OFF position.

7-3.5.8 Mounting Launchers on Aircraft. The launchers are mounted fully loaded and assembled. Proceed as follows:

1. Check out aircraft armament circuits as described in paragraph 7-3.5.7. Verify that all switches are in the OFF position.

2. Unlatch bomb hooks.

3. Loosen and extend sway braces as required.

4. Slice around edge of hanger nuts and remove protective tape.

5. To mount the Aero 6A launcher to the Aero 14 bomb rack suspension hooks, extend Aero 6A suspension lugs by turning the slotted plug 90 degrees in either direction.

6. To adapt the Aero 6A launcher to racks other than the Aero 14 rack series, remove hexagonal nut located at base of suspension hangers and, using the same threads, screw eye-nut hanger lug in its place.

NOTE: When Aero 6A1 suspension lugs are turned counterclockwise until fully extended, they will fit all bomb rack suspension hooks. The Aero 6A2 comes equipped with the eye-nut hanger lug and will fit all bomb rack suspension hooks.

7. Lift launcher into position and latch bomb hooks.

8. Tighten bomb rack sway braces

CAUTION: Do not overtighten sway braces as the rockets will be trapped in the launcher tubes by the deformation of the launcher bulkhead or strongback.

7-3.5.9 Installing Fairings. To install fairings on launchers, proceed as follows:

1. Tear tape off both ends of fairing container and push fairings out of drum, figure 7-7.

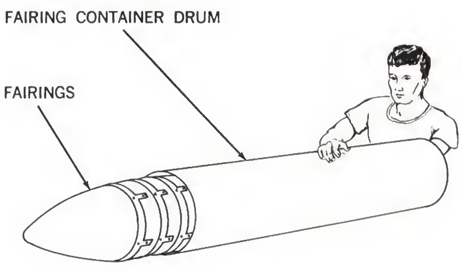


Figure 7-7. Unpacking Fairings.

FIRST REVISION

CAUTION: The fairings are easily damaged if handled roughly. Do not drop, squeeze, or strike unprotected fairings.

2. Install forward fairing in place. Make sure all attach clips properly engage the launcher bulkhead.

3. Position aft fairing as shown in figure 7-8.

4. Install aft fairing in place. Verify that all attach clips engage the launcher bulkhead.

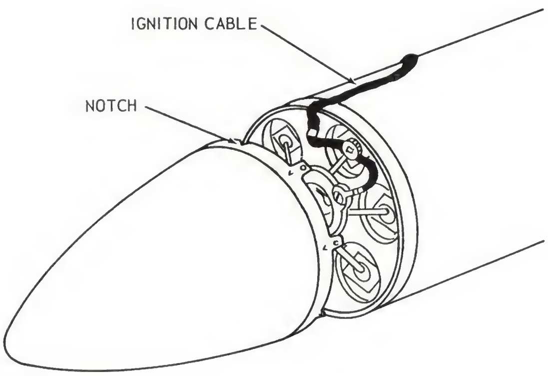


Figure 7-8. Installation of Aft Fairing.

CAUTION: Do not press on fairing nose or push sideways.

7-3.5.10 Connecting Ignition Cable. Immediately before takeoff, connect rocket launcher ignition cable to aircraft as follows:

WARNING

Stand to the side of the launcher when connecting ignition cable, in case inadvertent ignition should occur.

1. Check rocket firing receptacle of aircraft for stray voltage.

2. Remove shorting clip from jack plug.

3. Insert jack plug into receptacle and lock.

7-3.6 REMOVING LAUNCHER. If it is necessary to remove the launcher from the aircraft with unfired stores, move aircraft and point away from personnel and structures; then proceed as follows:

1. Unplug launcher and install ground clip.

2. In unloading area, remove fairings by prying each attach clip outward and sliding fairing off launcher.

3. Unload bomb hooks and lower launcher clear of pylon.

7-3.7 OPERATION. No new operating principles are involved in the Aero 6A series rocket launchers. The ignited rockets overcome their detents by the thrust force of the propulsive gases against the blast paddle of the detent and are guided by the launching tubes.

7-3.8 SERVICE INSPECTION. The Aero 6A series launcher inspection shall be conducted as follows:

1. Inspect launcher metal parts for corrosion, dents, or cracks with particular attention given to firing-contact fingers and ignition spider and tie rods.

2. Inspect launcher fiberboard case and paper tubes for presence of moisture, dents, wrinkles, and delamination.

Serviceable launchers are to be used in the repackaging of serviceable motors, while defective launchers are to be scrapped. Launchers with minor defects may be used. If launchers are to be stowed for future use, the openings in outer shell must be covered.

7-4 LAU-32A/A, LAU-32B/A, AND LAU-49/A AIRCRAFT ROCKET LAUNCHER PACKAGES

The LAU-32A/A, LAU-32B/A, and LAU-49/A shipper-launcher packages are used for shipping, stowing, and firing seven rounds each of completely assembled 2.75-inch FFARs.

The LAU-32A/A launcher is an expendable launcher with paper tubes and has a resistance-type intervalometer. The LAU-32A/A fires its seven 2.75-inch FFARs at 10-millisecond intervals in the ripple mode.

Unlike the LAU-32A/A, the LAU-32B/A is a reusable launcher made with metal tubes and may be reloaded. It has stronger firing fingers than the LAU-32A/A and a reusable intervalometer that may be set before takeoff for either the ripple- or single-fire mode.

The LAU-49/A has not been officially released and is subject to further modifications; therefore, no information is included in this publication.

7-4.1 SHIPPING CONFIGURATION. The LAU-32A/A and 32B/A shipping configuration, figure 7-9, consists of center section, reusable shock pan, locking rings, covers, RADHAZ barriers, and a container with eight frangible fairings.

The center section contains seven 2.75-inch FFARs, launcher tubes, suspension provisions, launcher ignition system, RADHAZ barriers, end covers, retainers, and locking rings. The center section and fairing container are both watertight. The rockets are held in place by flexible spring blast-paddle detents which release when the rocket blast impinges on the blast paddle. The RADHAZ barriers and the frangible fairings disintegrate when the rockets are fired (see figure 7-9). The RADHAZ barriers also act as shipping retainers to aid in securing the rockets during shipping and stowage.

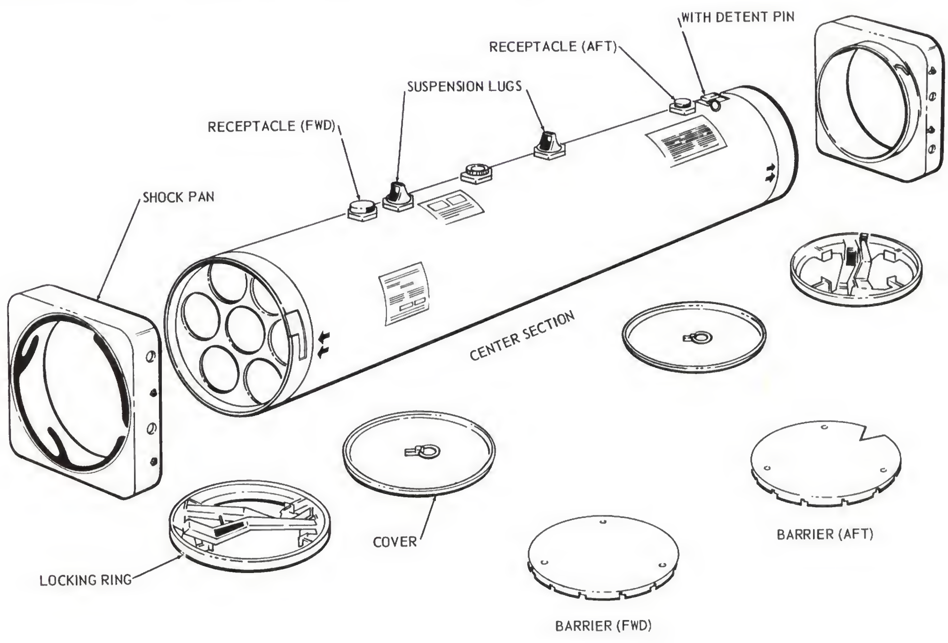


Figure 7-9. LAU-32A/A Launcher, Shipping Configuration.

Shock pans are square metal parts used to support the launcher center section when it is packaged for shipment or stowage (see figure 7-9). These shock pans give stability to the package for single or multiple stacking; they have locking slots for compressing the cover seal ring by means of a locking ring, thus sealing the center section and assuring a watertight container. The shock pans are removed when the fairings are installed.

7-4.2 AIRBORNE CONFIGURATION. The airborne configuration, figure 7-10, consists of the launcher center section (with shock pans, covers, and locking rings removed) containing seven FFARs, and frangible fairings which are securely locked in place.

7-4.2.1 Ignition. Electrical power is supplied to the launcher for the rocket ignition system by the 28-volt DC armament system of the aircraft. Two receptacles are provided for making electrical contact (see figure 7-9). The receptacle to be used is determined by the type of bomb rack. A breaker switch with detent pin is used as the safety and arming device (see figure 7-9).

7-4.2.2 Suspension Provisions. The LAU-32 series launchers are equipped for 14-inch suspension only.

7-4.2.3 Frangible Fairings. Frangible fairings (see figure 7-10) are attached to the forward and aft ends of the center section after the center section has been attached to the aircraft. The fairings shatter readily from rocket impact or blast. A metal band at the base of each fairing has lugs which engage grooves in the center section end rings. As the fairing is rotated clockwise, a leaf spring clip locks the fairing in place. When attached, the fairing is flush with the outside surface of the center section and forms an aerodynamically smooth joint. The aft fairing is a one-piece unit similar to the forward fairing, but is constructed differently because of the function it performs. Fairings are marked FRONT and REAR.

7-4.2.4 Special Tools. No special tools are required.

7-4.3 LAU-32A/A AND 32B/A AIRCRAFT ROCKET LAUNCHER PACKAGE SPECIFICATIONS. The following are the specifications for the shipping configuration, both empty and loaded, and the airborne configuration, both empty and loaded.

7-4.4 PREPARATION FOR USE. The LAU-32 series rocket launcher packages are shipped completely assembled with shock pans, covers, and locking rings attached. The empty

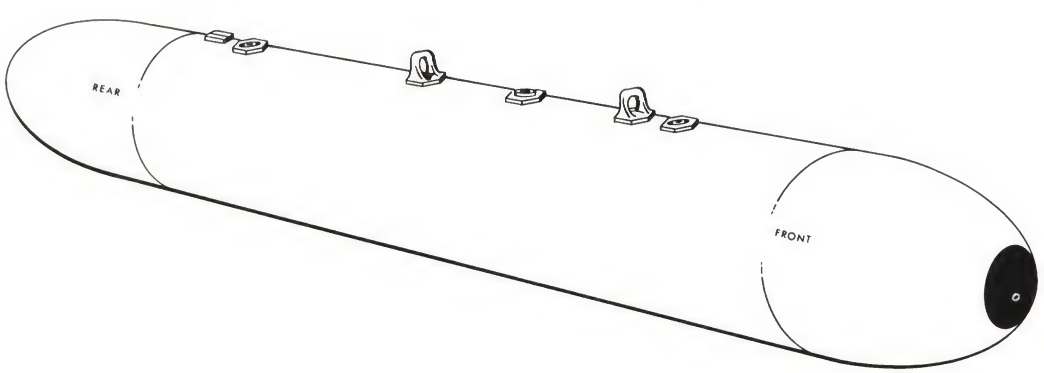


Figure 7-10. LAU-32A/A Launcher, Airborne Configuration.

launcher is shipped to the ammunition depot where it is partially disassembled and loaded with seven 2.75-inch FFARs complete with warheads attached. The loaded launchers then are stowed or placed in service.

Shipping Configuration:

Overall Length (in.)	53.30
Cross Section (in.)	12.2 x 12.62
Capacity (rockets)	7
Weight, empty (lb)	71.00*
Weight, loaded (lb)	195.25
Suspension	14-in. and center

Airborne Configuration:

Overall Length (in.)	67.10
Cross Section (in.)	9.8
Capacity (rockets)	7
Weight, empty (lb)	43.60*
Weight, loaded (lb)	167.85
Suspension	14-in. and center
Ignition	28-volt DC
Firing Rate Ripple	10-millisecond interval
Operating Temperature (°F) Range	-65 to 165

* The LAU-32B/A is of metal and is heavier. It has two modes of firing, SINGLE or RIPPLE.

7-4.4.1 Shipper Loading. To load the launcher for shipping and stowing, it is necessary to remove the locking rings, covers, and RADHAZ barriers (see figure 7-9). Disassemble the launcher as follows:

1. Break safety wire holding locking ring on.

2. Lift handles from spring catches on locking ring assembly and swing outward to convenient position. Do not engage handle clips with shock pan.

3. Rotate handles counterclockwise until pins on locking ring disengage slots in shock pan, and remove.

4. Lift out cover.

5. Remove RADHAZ barriers by removing three screws in each barrier.

7-4.4.2 Loading Rockets in Launcher. To load rockets in launcher proceed as follows:

CAUTION: Launcher must be in horizontal position for loading. Rocket warheads must be attached to rocket motors before installing in launcher.

1. Align fins of rocket so that arrow mark on forward bulkhead is between two fins. Arrow mark indicates the detent position in launcher tube, figure 7-11.

2. Insert fin end of rocket slowly into launcher tube until rocket detent groove snaps into position over launcher detent latch.

CAUTION: To prevent damage, do not ram rocket against detent. Slide gently into place.

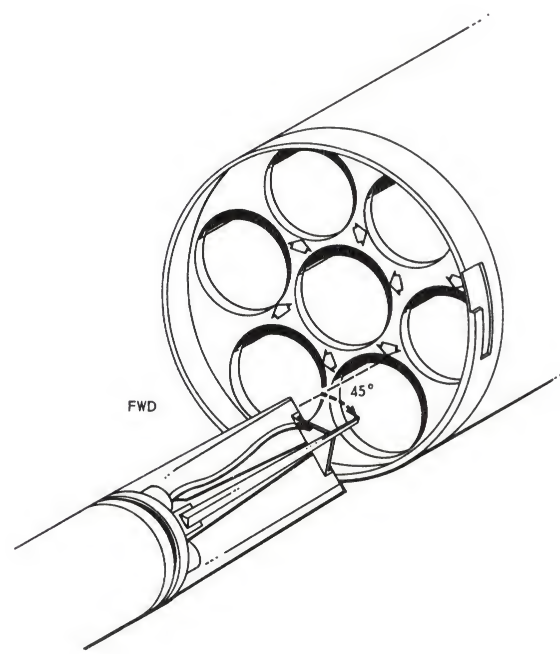


Figure 7-11. Loading 2.75-Inch FFARs into LAU-32A/A Launcher Tube.

3. Repeat steps 1 and 2 until seven rockets have been loaded into launcher tubes.

7-4.4.3 Assembly of Loaded Launcher. Proceed in the following manner when assembling the loaded launcher:

1. Replace RADHAZ barriers.

2. Replace shipping retainer, pressing down until retainer is even all the way around.

3. Check to make sure rubber seal ring on cover is properly installed in groove and free of foreign material.

4. Install cover.

5. Install locking ring assembly by engaging pins in slots on shock pan and by rotating locking ring clockwise until pins bottom at ends of slots.

6. Fold handles downward and snap into spring catches.

7. Using safety wire, secure locking ring assembly in place using one pin and hole provided in shock pan.

7-4.4.4 Testing Aircraft Armament Circuit. Proceed in accordance with current instructions to check firing circuit for voltage.

WARNING

This launcher must have a 5-ohm, 10-watt, resistor in the firing circuit.

1. Increase engine speed until cockpit voltmeter indicates full system voltage, 28 volts.

2. Connect an ammeter, 0 to 10-ampere range, directly to rocket firing receptacle.

NOTE: The greatest single cause of firing failure is insufficient power at the electrical outlet.

3. Energize the station where the ammeter is connected, and note reading. (The ammeter should register between 4.5 and 7.5 amperes.)

NOTE: A pulse less than 4.5 amperes may not fire the entire load. If the pulse exceeds 7.5 amperes, the firing delay time will be reduced, resulting in a more rapid firing rate.

4. Place armament switches in OFF position.

7-4.4.5 Attaching Launcher to Aircraft. When preparing the launcher for attachment to aircraft, proceed as follows:

1. Remove locking rings, shipping covers, and shock pans. Leave RADHAZ barriers in place.

2. Remove waterproof bag attached to hanger lug. (This bag contains the striker post and jumper cable.)

3. Determine method to be used to make electrical connection between bomb rack and launcher. Remove dust cap from appropriate receptacle on launcher.

a. For the Aero 14 and 15 series bomb racks, use striker post in forward receptacle. Insert striker post in receptacle in the correct position which is indicated by the word FWD or will be indicated by a projection on the post, figure 7-12.

b. Remove dust cap from aft receptacle and install jumper cable, figure 7-13, or

c. Remove appropriate dust cap for heavy duty bomb racks.

WARNING

The armament switch on the aircraft must be in the OFF position and the detent pin must be in the safety switch.

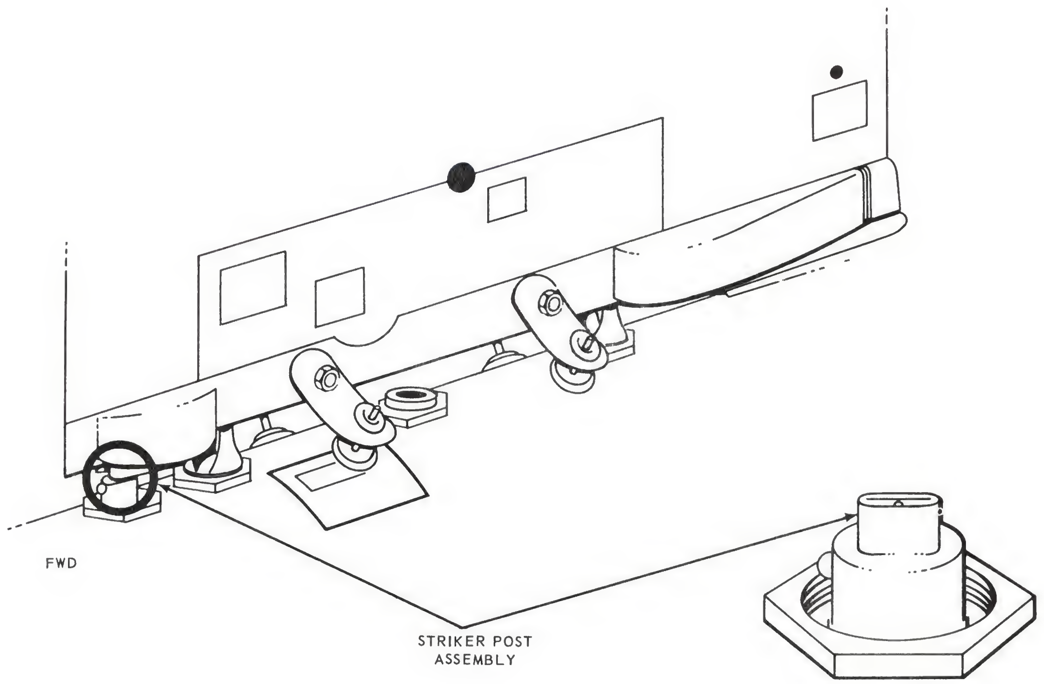


Figure 7-12. Installation of Striker Post.

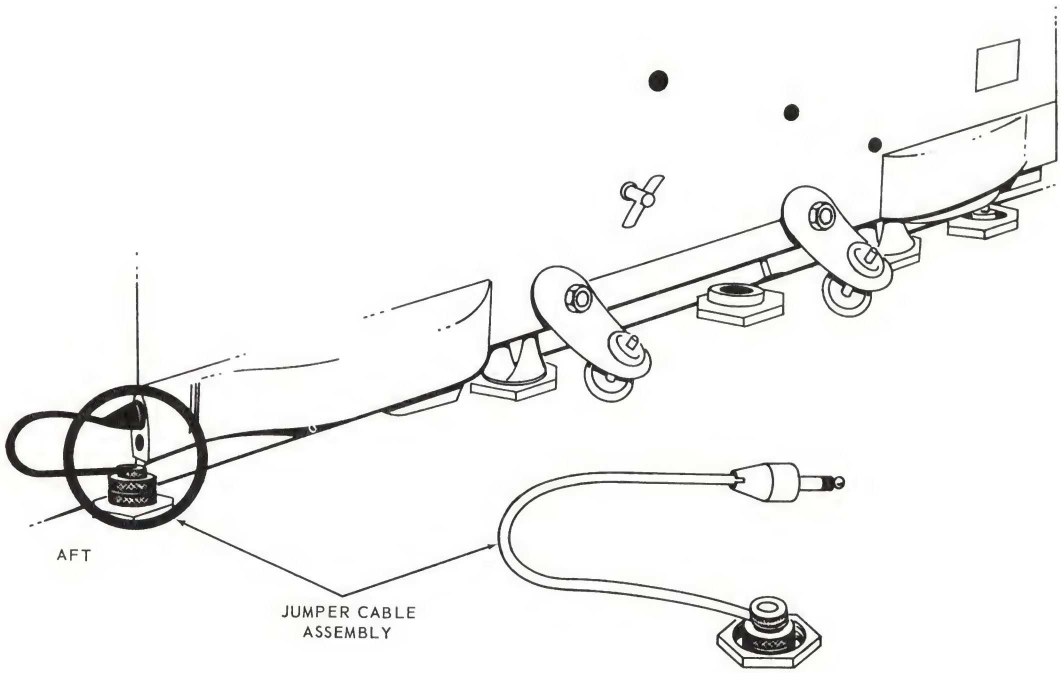


Figure 7-13. Installation of Jumper Cable.

4. Prepare bomb rack to receive launcher according to appropriate bomb rack instructions.

5. Position launcher in bomb rack and secure bomb hooks.

> CAUTION: If the forward striker post is used, exercise care to prevent damage to the post.

6. Secure sway braces according to bomb rack instructions. A slight depression of the launcher skin may be noticed. This is normal, as the skin is loose over the strongback.

7-4.4.6 Installing Fairings. The forward and aft fairings perform different jobs and, therefore, are constructed differently.

> NOTE: It would be better to leave the fairings off the launcher than to install an aft fairing in the forward position.

Proceed as follows:

1. Install forward fairing by lifting spring catch and rotating fairing clockwise.

2. Install aft fairing.

7-4.4.7 Arming Launcher. Immediately before takeoff, make a stray voltage check following applicable instructions. After stray voltage check, proceed as follows:

1. If forward striker post is used, lower striker arm or plug jumper cable in receptacle as applicable.

2. Pull detent pin out of safety switch.

7-4.5 DISARMING LAUNCHER. Immediately after an aircraft lands with a full or partial load, move aircraft away from personnel and structures and disarm the launcher in the following manner.

1. Insert detent pin in safety switch.

2. Disconnect launcher package from aircraft by (a) removing jumper harness or (b) raising striker arm of Aero 14 or 15 bomb racks.

3. In unloading area, remove fairings by lifting spring catch and rotating fairings counterclockwise.

4. While giving adequate support to the launcher, trip manual release of rack and lower launcher.

7-4.6 UNLOADING LAUNCHER. Should it be necessary to unload a full or partial load, proceed as follows:

WARNING

> The following steps are to be conducted in a RADHAZ safe area.

1. Insert long screwdriver or other suitable probe under detent extension arm into aft end of launcher tube. Lift detent away from rocket and push against rocket contact button at the same time. The rocket will slip free of the detent.

2. Return unfired rockets to the magazine for disposition in accordance with current directives.

7-4.7 DISPOSITION OF LAUNCHER LOADS UNDER VARYING CONDITIONS. Disposition of fired, partially fired, and unfired loads shall be made in the following manner:

1. During shipboard operation, it is recommended that all fired and partially fired LAU-32A/A launchers be jettisoned from the aircraft before landing aboard ship. Do not jettison LAU-32B/A launchers as they are reusable.

2. When no attempt was made to fire the launchers, the unfired launcher loads may be returned aboard

ship. Such launchers may be left on the aircraft, or may be disassembled and returned to the magazines.

3. When an attempt was made to fire, unfired launchers shall be inspected to determine if the armament procedure was accomplished correctly. If determined that the misfire was the result of a launcher malfunction, salvage the rockets but dispose of the launcher.

7-4.8 DISPOSITION OF LAUNCHER SHIPPING PROTECTORS AND EXTRA SUSPENSION LUGS. Dependent upon the nature of shipboard operation, disposition of launcher shipping protectors and extra suspension lugs shall be accomplished in the following manner:

1. During any emergency or combat operation, all excess shipping gear may be jettisoned.

2. During noncombat operation where return logistics are adequate and economical, retain shock pans, locking rings, covers, and spare suspension lugs for palletizing and return shipment to the ammunition loading depot.

7-4.9 PREPARATION FOR RESHIPMENT. To pack launchers for reshipment, reverse the procedures described in paragraph 7-5.4.1.

7-4.10 OPERATION. The LAU-32A/A launcher has a resistance-type intervalometer which fires seven 2.75-inch FFARs at 10-millisecond intervals. The LAU-32B/A has a reusable intervalometer that can be set for either ripple or single firing before takeoff.

7-4.11 SERVICE INSPECTION, MAINTENANCE, AND LUBRICATION. The launchers shall be inspected for cracked launcher tubes and the firing contacts shall be checked. No maintenance or lubrication is required.

7-5 AERO 7D, LAU-3/A, LAU-3A/A, LAU-50/A, AND LAU-51/A AIRCRAFT ROCKET LAUNCHER PACKAGES

The Aero 7D, LAU-3/A, and LAU-3A/A launchers are expendable shipper-launcher packages for shipping, stowing, and firing 19 completely assembled 2.75-inch FFARs. They are suitable for air-to-ground or air-to-air rocket launching.

The LAU-50/A and 51/A launchers have not been released officially and are subject to further modifications; therefore, they are not included in this publication.

7-5.1 SHIPPING CONFIGURATION. The Aero 7D, LAU-3/A, LAU-3A/A shipping configuration, figure 7-14, consists of a center section, reusable shock pans, and frangible fairings. The center section contains 19 assembled 2.75-inch FFARs in launching tubes, suspension provisions, launcher ignition system, end covers, rubber retainers, and locking rings. The frangible fairings are shipped and stowed in a separate container (see figure 7-14). Each fairing container has six frangible fairings. Both the center section and fairing container are watertight.

7-5.1.1 Launcher Center Section. The launcher center section is constructed of 19 thermosetting plastic-impregnated paper tubes clustered and bonded to form an integral part of the structure. This cluster is contained in an aluminum skin. The ends are closed and supported with metal bulkheads. External suspension lugs are screwed into thread inserts for attaching the launcher to the aircraft bomb rack. In each launcher tube, the rocket is held in place by a flexible metal spring detent; when the rocket is fired, the rocket blast releases this detent.

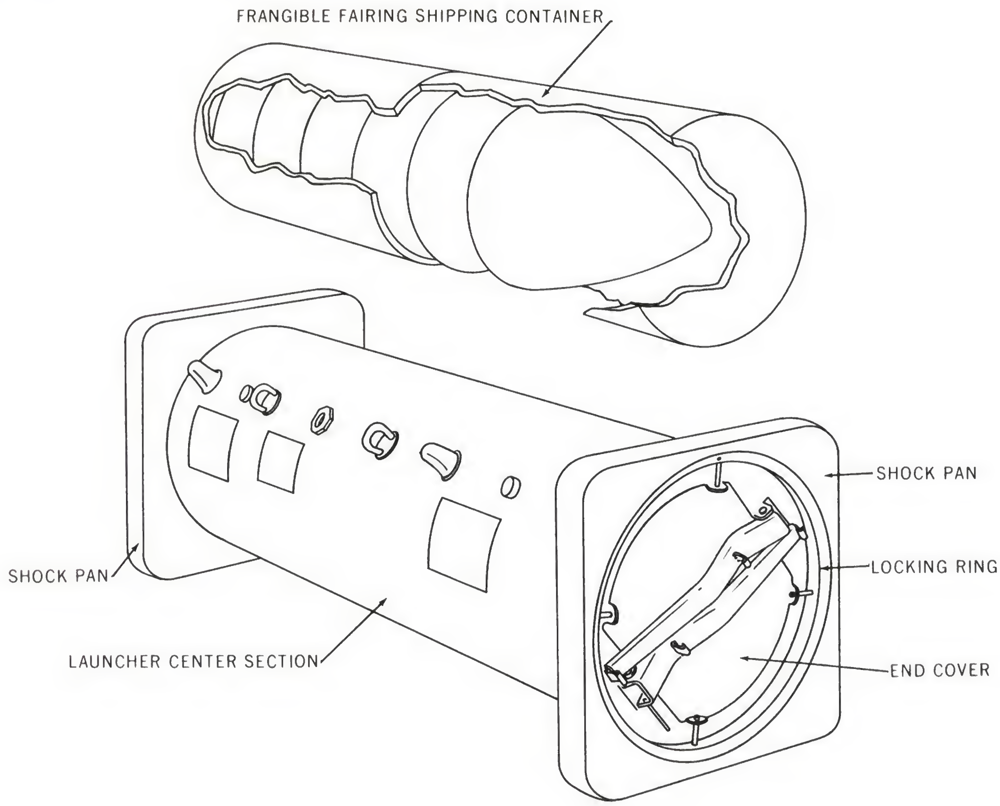


Figure 7-14. Aero 7D, Shipping Configuration.

7-5.1.2 Shipping Retainers. A pad is fitted to the front of the package to support the rocket nose should any rocket become dislodged from its detent during shipping or stowing. A pad is fitted to the rear of the package to support the rocket fin retainers during shipment and stowage. These shipping retainers are removed from the Aero 7D and the LAU-3/A when the fairings are installed, but they are left on the LAU-3A/A launcher because they are a part of the RADHAZ protection.

7-5.1.3 Shock Pans. Shock pans are square metal parts used to support the ends of the launcher center section when it is packaged for shipment and stowage (see figure 7-14). These shock pans give stability to the launcher for single or multiple stacking, and they contain locking slots for compressing the cover seal ring by means of a locking ring assembly which seals the center section and assures a watertight container. The end pans are removed when the fairings are installed.

7-5.2 AIRBORNE CONFIGURATION. The airborne configuration, figure 7-15, consists of the launcher center section, containing 19 assembled rockets (2.75-inch FFAR), and frangible fairings attached and securely locked in place on each end.

7-5.2.1 Ignition. Electrical power for the rocket ignition system is supplied to the launcher by the 28-volt DC armament circuit of the aircraft. Two receptacles are provided for making contact. One receptacle is located near the forward end of the center section, the other near the

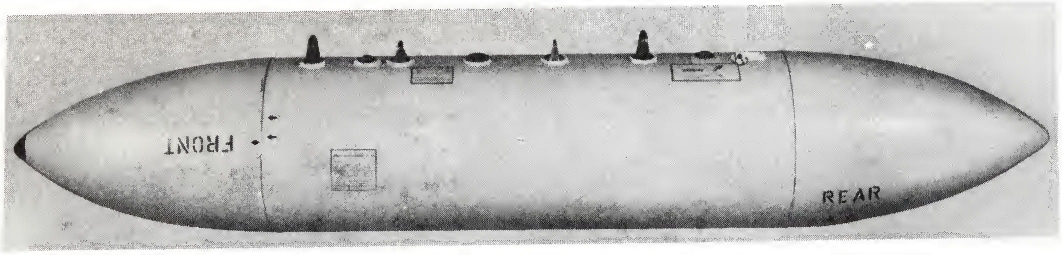


Figure 7-15. LAU-3A/A Launcher, Airborne Configuration.

aft end of the center section. Either receptacle may be used for making contact. The type of bomb rack used with the launcher determines which receptacle is used. On aircraft using bomb racks with striker arms (Aero 14 or Aero 15 combination bomb rack and rocket launcher pylon), the post assembly is inserted in the forward receptacle of the launcher. Grounding of the circuit is provided through the suspension lugs which attach the launcher to the aircraft. As a safety precaution, shorting buttons for the Aero 7D are placed in each receptacle, figure 7-16. The shorting buttons are not removed from the receptacles until connections are made and just before the aircraft is ready for flight.

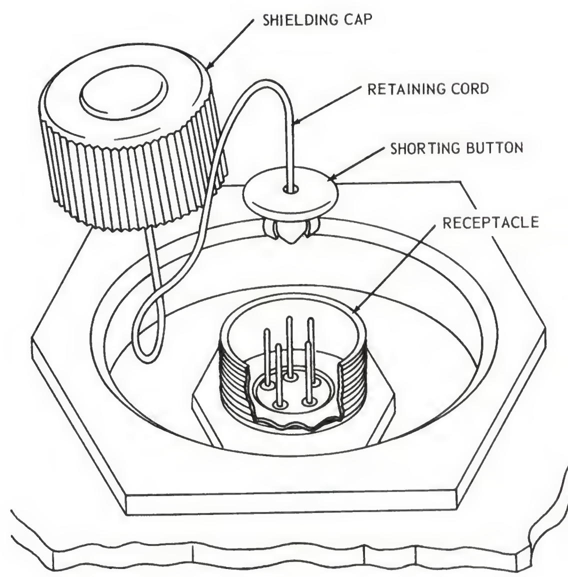


Figure 7-16. Aero 7D Shorting Button Installation.

As a safety precaution for the LAU-3/A, a sliding safety and arming device is installed on each receptacle, figure 7-17. One safety and arming device is removed from the receptacle which is used to fire the rockets, while the other is left in place on the launcher and moved into the FIRE position at the time the aircraft is armed. The LAU-3A/A incorporates a pin-operated safety switch for SAFE and ARM conditions. For the LAU-3A/A launcher the detent pin is pulled from the breaker switch at aircraft

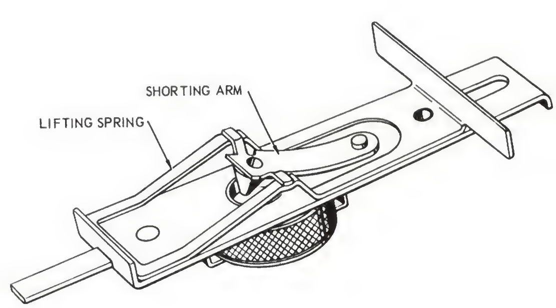


Figure 7-17. Safety and Arming Device.

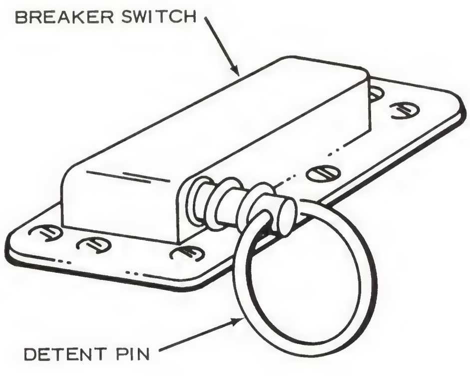


Figure 7-18. Pin-Operated Safety Switch for LAU-3A/A.

arming time, figure 7-18. When fired, current passes through an intervalometer which ripple-fires the rockets in pairs at 10-millisecond intervals.

The firing pulse is distributed to the individual rockets by a shunt-fuse intervalometer which is installed through the aft bulkhead into the wiring harness receptacle. The intervalometer has no moving parts and requires no maintenance. The wiring of the intervalometer converts the firing pulse to ripple-firing with a 10-millisecond delay interval.

WARNING

A 5-ohm, 10-watt resistor must be in series with the launcher. Failure to install this resistor will result in salvo of all rockets and possible damage to the aircraft.

7-5.2.2 Suspension Provisions. Multiple suspension provisions (see figure 7-15) make the Aero 7D, LAU-3/A, and LAU-3A/A adaptable to most Navy and Air Force tandem 14-inch and 30-inch bomb racks, and United Kingdom bomb racks with single bomb hooks. Threaded suspension lugs that are not being used on a particular bomb rack are removed to provide minimum weight and maximum clearance for each installation.

7-5.2.3 Frangible Fairings. Frangible fairings (see figures 7-14 and 7-15) are attached to the forward and aft ends of the center section after the center section has been attached to the aircraft. The launcher fairings shatter readily from rocket impact or blast. A metal band at the base of each fairing has lugs which engage grooves in the center section end rings. As the fairing is rotated clockwise, a leaf spring clip locks the fairing in place. When attached, the fairing is flush with the outside surface of the center section and forms an aerodynamically smooth joint.

7-5.2.4 Special Tools. No special tools are used in conjunction with the Aero 7D, LAU-3/A, and LAU-3A/A aircraft rocket launchers.

7-5.3 TRAINING ROCKET LAUNCHER. An SMU 7 kit (FSN 2T 1340-858-5875-X394) is mounted in place of the intervalometer on the LAU-3/A and LAU-3A/A launchers and gives nine firings of two rounds each for purposes of Fleet training. Instructions on the installation and operation of this unit are included with each kit.

7-5.4 AERO 7D, LAU-3/A, AND LAU-3A/A AIRCRAFT ROCKET LAUNCHER PACKAGE SPECIFICATIONS. The following are the specifications for the shipping configuration with and without rockets and the airborne configuration with and without rockets.

	Shipping configuration	Airborne configuration
Overall Length (in.)	53.3	98.6
Cross Section (in.)	18 x 18	15.7
Capacity (rounds)	19	19
Weight, empty (lb)	129.8	74.3
Weight, loaded (lb)	487.7	430.9
Suspension	Multiple	Multiple
Firing Rate, interval, ms.	10	10
Fairing Container, loaded (lb)	44	44
Operating Temperature Range, °F	-65 to 165	-65 to 165

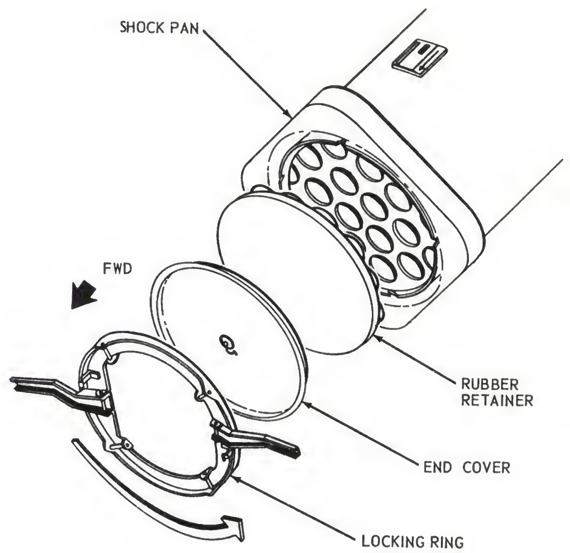


Figure 7-19. Locking Ring, Cover, and Rubber Retainer Removed.

7-5.5 PREPARATION FOR USE. The Aero 7D, LAU-3/A, and LAU-3A/A rocket launchers are shipped completely assembled with forward and aft shock pans, covers, and locking rings attached. The empty launcher is shipped to the ammunition loading depot where it is partially disassembled and loaded with nineteen 2.75-inch FFARs complete with warheads attached. The loaded launchers then are stowed or placed in service.

7-5.5.1 Shipper Loader. To load the launcher for shipping and stowing, it is necessary to remove forward locking ring, cover, and rubber retainer, figure 7-19. Disassemble the launcher as follows:

1. Break safety wire that holds locking ring on.

2. Lift handles from spring catches on locking ring and swing outward to convenient leverage position. Do not engage handle clips with shock pan.

3. Rotate handles counterclockwise until pins on locking ring disengage slots in shock pan, and remove.

4. Lift out cover and shipping retainer.

7-5.5.2 Loading Rockets in Launcher. To load rockets in launcher, proceed as follows:

CAUTION: Launcher must be in a horizontal position for loading. Rocket warheads must be attached to motors before installing in launcher.

1. Align fins of rocket so that arrow mark on the forward bulkhead is between two fins. Arrow marks indicate the detent position in the launcher tube, figure 7-20.

2. Insert fin end of rocket slowly into launcher tube until rocket detent groove snaps into position over launcher detent latch.

CAUTION: To prevent damage, do not ram rocket against detent. Slide gently into place.

3. Repeat steps 1 and 2 until 19 rockets have been loaded into launcher.

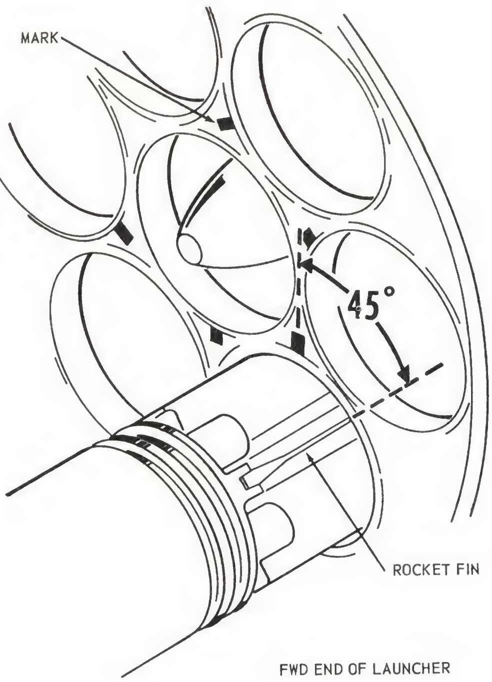


Figure 7-20. Alignment of Fins.

7-5.5.3 Rocket Continuity Check (NAD Only). Rocket ignition circuit check is performed in accordance with ammunition depot procedures.

1. If continuity is not obtained, check rockets to make certain that detents are latched.

> NOTE: Rocket is not latched if warhead protrudes from launcher, or if rocket can be easily pulled out of launcher tube.

2. Remove rocket from launcher tube, if any detent is not latched.

3. Check visually for flaws; then reinsert rocket.

4. Repeat continuity test.

5. If continuity is not obtained, reject launcher and report it to the Bureau of Naval Weapons.

7-5.5.4 Assembly of Loaded Launcher. Proceed in the following manner when assembling the loaded launcher:

1. Replace shipping retainer and press down until retainer is even all the way around.

2. Check to make sure rubber seal ring on cover is properly installed in groove and free of foreign material.

3. Install cover.

4. Install locking ring by engaging pins in slots on shock pan and rotating locking ring clockwise until pins bottom at end of slots.

5. Fold handles downward and snap into spring catches.

6. Using safety wire, secure locking ring in place by using one pin and hole provided in shock pan.

7-5.5.5 Testing Aircraft Armament Circuit. Proceed in accordance with current instructions to check firing circuit for voltage.

1. Increase engine speed until cockpit voltmeter indicates full system voltage, 28 volts.

2. Connect ammeter, 0 to 10-ampere range, directly to rocket firing receptacle.

> NOTE: The greatest single cause of firing failure is insufficient power to the electrical outlet.

3. Energize station where ammeter is connected, and note reading. (The ammeter should register between 4.5 and 7.5 amperes.)

> NOTE: A pulse less than 4.5 amperes may not fire the entire rocket load. If the pulse exceeds 7.5 amperes, the firing delay time will be reduced, resulting in a more rapid firing rate.

4. Place armament switches in OFF position.

7-5.5.6 Attaching Launcher to Aircraft. Proceed as follows:

1. Remove striker post from waterproof bag attached to aft locking ring (Aero 14 and 15 bomb racks only).

2. Remove front receptacle dust cap or safety and arming device (whichever is applicable), and install striker post. The correct position of the striker post on the receptacle should be determined by examining the post. It will be marked either FWD, figure 7-21, or will have a raised projection. In either case, the striker post should be installed with the mark FWD or raised projection facing forward on the launcher.

3. On the Aero 7D launcher, unscrew rear receptacle dust cap and allow it to hang by line attached to shorting button. On the LAU-3/A launcher, remove safety wire from rear safety and arming device, but leave it on the SAFE position. On the LAU-32A/A launcher, do not pull the safety and arming pin at this time.

4. For bomb racks using rear receptacle for firing, remove rear protecting safety and arming device and prepare forward receptacle as in step 3.

5. Remove extra suspension lugs that are not required, and remove dust cap from center threaded insert.

6. Place bomb rack on aircraft for accepting suspension lugs in accordance with aircraft operating instructions.

7. Rotate launcher on ground to position shown in figure 7-21, and lift handles from spring catches (both ends) and swing outward.

WARNING

Make sure spring clips are firmly engaged with the shock pans before manually handling the launcher. Failure to do so may result in serious injury to personnel.

8. Lock handles in carrying position by engaging spring clips on handles in holes in shock pans (see figure 7-21).

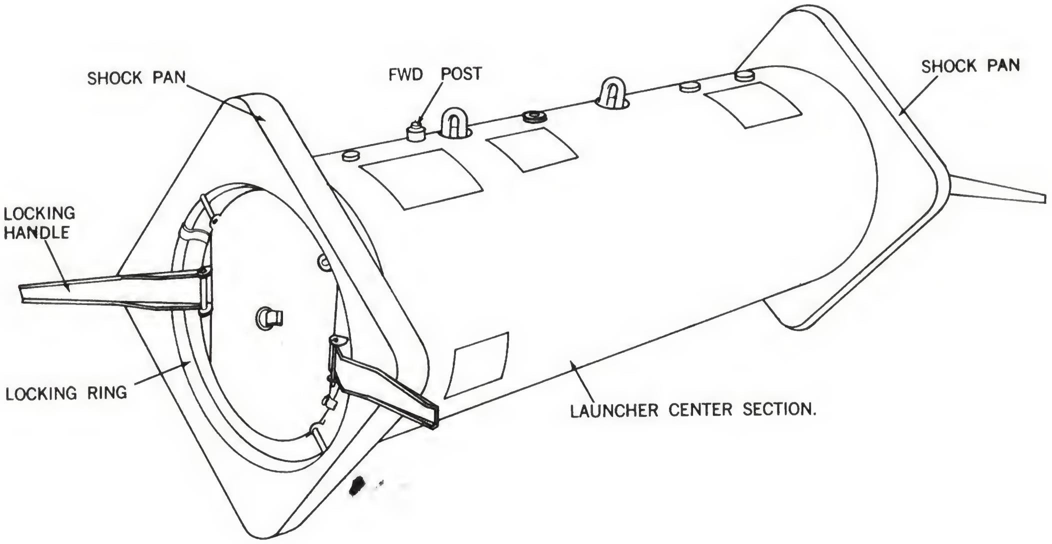


Figure 7-21. Launcher, Prepared for Lifting.

9. Grasp four handles, bring launcher into position on bomb rack, and lock suspension lug hooks.

10. Tighten sway braces on bomb rack to support launcher in accordance with aircraft operating instructions. No damage is done if launcher skin deforms.

11. Remove forward and aft locking rings, covers, and shipping retainers as follows:

a. Remove safety wire from locking ring.

b. Rotate locking ring counterclockwise until pins disengage slots in shock pan.

c. Remove locking rings.

d. Remove covers and shipping retainers on Aero 7D and LAU-3/A launchers, but do not remove shipping retainers on LAU-3A/A launcher as they provide RADHAZ protection. Upon firing, the rockets penetrate the RADHAZ barriers on the LAU-3A/A and disintegrate them.

12. Lift spring latch on shock pan just far enough to disengage latch. (Lifting too far will bend the spring and cause it to take a permanent set.)

13. Rotate shock pan counterclockwise as far as possible and pull away from center section.

7-5.5.7 Installing Fairings. The fairings are installed as follows:

1. Remove two frangible fairings from container.

2. Install one on each end of center section. (The LAU-3/A and LAU-3A/A launcher fairings are marked FORE and AFT. The procedures are as follows:

a. Align arrow on fairing with UNLOCK arrow on launcher.

b. Slip fairing on center section until end of launcher is fully engaged.

WARNING

Failure to lock the launcher fairing into proper position will cause loss of the fairing band at firing, which will endanger the aircraft and pilot.

c. Rotate fairing clockwise until spring catch snaps into locked position. Red arrow on fairing is then aligned with red arrow on launcher marked LOCK.

7-5.5.8 Arming Launcher. Immediately before takeoff of aircraft, proceed as follows:

1. Perform stray voltage check at receptacle in accordance with current directives.

2. Drop Aero 14 or 15 contact pins of striker arm onto forward contact post, or plug jumper harness into Aero 20A bomb rack or other heavy duty bomb rack plug-in station.

3. Remove remaining shorting button from unused electrical receptacle on Aero 7D launcher by pulling on shielding cap (see figure 7-16). Move safety and arming device on LAU-3/A to ARM position. Pull out safety pin on safety arming device of LAU-3A/A, and expose red safety flag.

WARNING

Inspect the Aero 7D launcher receptacle to make sure that the line holding the shorting button did not break, leaving the launcher shorted.

4. Hold Aero 7D shorting button up for pilot to see, if practicable, to indicate completion of arming procedure.

5. Retain shorting button for reuse should the pilot not fire the launcher.

CAUTION: Never throw away the Aero 7D shorting button and dust cap, or the LAU-3A/A safety pin, where it is possible for them to be picked up by a jet aircraft intake. Severe engine damage may result.

7-5.6 DISARMING LAUNCHER. Immediately after an aircraft lands with a full or partial load, move aircraft to disarming area and point away from personnel and structures, and disarm the launcher as follows:

1. Insert detent pin in safety switch.

2. Reinsert both shorting buttons in receptacles.

3. Disconnect launcher from aircraft by (a) removing jumper harness or (b) raising striker arm of Aero 14 or 15 bomb racks.

4. In the unloading area, remove fairings by lifting spring latch and rotating fairings in counterclockwise direction.

5. While giving adequate support to the launcher, trip manual release of rack and lower launcher.

7-5.7 UNLOADING LAUNCHER. Should it be necessary to unload a full or partial load, perform step 1 or 2 as appropriate:

WARNING

The following steps are to be conducted in a RADHAZ safe area.

1. For the Aero 7D launcher only, grip the nose fuze at the wrenching flat with a U-shaped tool, and rotate clockwise while pulling at the same time. The motor fin assembly will raise the detent, releasing the rocket from the launcher tube.

2. For the LAU-3/A and LAU-3A/A launcher (also if step 1 fails for the Aero 7D), insert a long screwdriver or other suitable probe into aft end of launcher tube, place tool under detent extension arm, lift detent away from rocket, and push against rocket contact button at the same time. The rocket will slip free of the detent.

3. Return unfired rockets to the magazine for disposition in accordance with current directives.

7-5.8 DISPOSITION OF LAUNCHER LOADS UNDER VARYING CONDITIONS. Disposition of empty launcher and partially fired or unfired loads shall be made in the following manner:

1. During shipboard operation, it is recommended that all launchers, fired and partially fired, be jettisoned from the aircraft before landing aboard ship.

2. When no attempt was made to fire the launchers, the unfired launchers may be returned aboard ship. These launchers may be left on the aircraft or returned to the magazine or stowage area.

3. When an attempt was made to fire, unfired launchers shall be inspected to determine if the armament procedure was accomplished correctly. If determined that the misfire was the result of a launcher malfunction, salvage the rockets and dispose of the launcher.

7-5.9 DISPOSITION OF LAUNCHER SHIPPING PROTECTORS AND EXTRA SUSPENSION LUGS. Dependent upon the nature of shipboard operation, disposition of the launcher shipping protectors and extra suspension lugs shall be accomplished in the following manner:

1. During any emergency or combat operation, all excess shipping gear may be jettisoned.

2. During noncombat operations, where return logistics are adequate and economical, retain shock pans, locking rings, covers, and spare suspension lugs for palletizing and return shipment to the ammunition loading depot.

7-5.10 PREPARATION FOR RESHIPMENT. To pack launcher for reshipment, perform the reverse of procedures in paragraph 7-6.5.

7-5.11 OPERATION. In operation, the ignited rockets overcome the detent by blasting against the inclined plane of the detents and releasing the rockets. This does not restrain the forward motion of the rocket. The firing impulse is distributed to the rockets by a shunt-fuse intervalometer which is "lugged in" to the launcher aft bulkhead. The wiring of the intervalometer converts the aircraft firing pulse into ripple-firing with a 10-millisecond delay interval. The frangible fairings shatter readily from rocket impact and backblast.

Operation of the launcher is accomplished through the standard armament system in the aircraft. The pulse is dispersed to the rockets in pairs except the last one, which is a single-fire. A separate electrical impulse to the release solenoid of the bomb rack is required to jettison the launcher after firing, or in case of an emergency.

7-5.12 CHANGING ROCKET WARHEADS. Should it be necessary to change rocket warheads, remove rockets from launcher as discussed in paragraph 7-5.7.

7-5.13 MAINTENANCE INSTRUCTIONS. The Aero 7D and LAU-3/A launchers are expendable, and no adjustments or maintenance are required. The LAU-3A/A is reusable.

7-5.14 CAUSES OF MISFIRES. The following are causes of misfires on the Aero 7D, LAU-3/A, and LAU-3A/A launchers:

1. The launcher intervalometer requires a minimum firing pulse of approximately 150 milliseconds; therefore, failure to fire all rockets usually indicates that the aircraft stepper switch did not rest on the bomb rack firing circuit station long enough to energize all 19 rockets.

2. If all rockets remain after repeated attempts to fire, it is probable that the launcher did not receive a firing pulse.

3. Partial fireouts may be caused by several types of malfunctions such as the following:

a. An interrupted firing pulse.

b. An intervalometer failure.

c. Rocket off the detents.

d. Contact finger not touching the contact button.

e. Blast from one rocket loosened adjacent contact fingers.

f. Blown holes in firing tubes broke the ignition harness.

7-6 LAU-10/A AIRCRAFT ROCKET LAUNCHER PACKAGE

The LAU-10/A aircraft rocket launcher package is a reusable dual-purpose store, which houses four 5.0-inch FFAR motors (ZUNI) from the time of manufacture until assembled with warheads and fuzes and fired at the target.

7-6.1 SHIPPING CONFIGURATION. The shipping configuration, figure 7-22, consists of two packages: the launcher center section, containing four motors, shock pans, covers, and locking rings installed; and the fairing container with six frangible fairings, enough to equip three launchers.

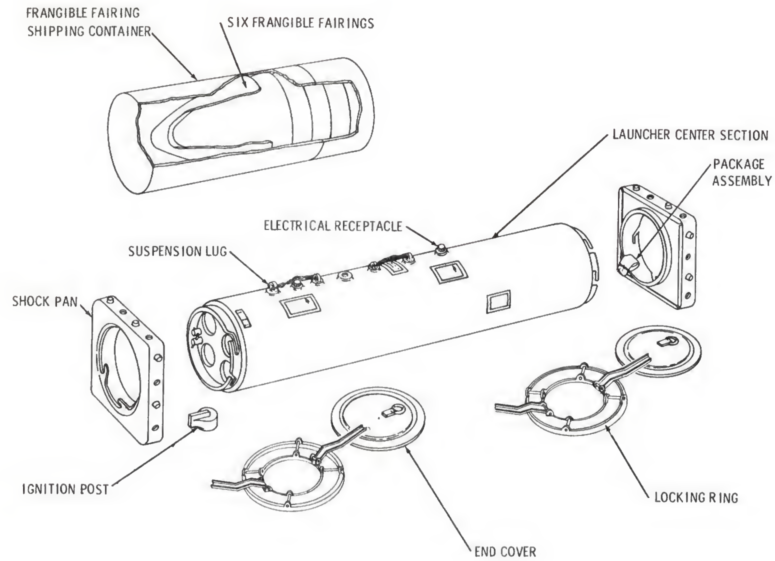


Figure 7-22. LAU-10/A Launcher, Shipping Configuration.

7-6.1.1 Launcher Center Section. The launcher center section (see figure 7-22) contains four launching tubes, the electrical ignition system, suspension lugs, and a sear-type detent latch.

7-6.1.2 Shock Pans. The shock pans (see figure 7-22) comprise a multipurpose arrangement consisting of the pans, covers, and locking rings. The shock pan is a heavy metal picture-frame structure, which gives stability and rigidity. It is equipped with an alternate hole and pin arrangement on the sides, so arranged that when launchers are stacked the shock pans interlock. The cover has a rubber seal ring which, when compressed by the locking ring, forms a watertight closure over the end of the launcher. The locking ring fits into grooves in the shock pan, holds the cover in place, and compresses the seal ring. In additio the locking ring has handles that can be hinged back perpendicular to the horizontal centerline of the launcher and latched to the shock pans by mea of a spring-loaded pawl to facilitate handling.

7-6.1.3 Frangible Fairings. Six frangible fairings are shipped in a separate container (see figure 7-22).

7-6.2 AIRBORNE CONFIGURATION. The airborne configuration, figure 7-23, consists of a launcher center section (with the shock pans, covers,

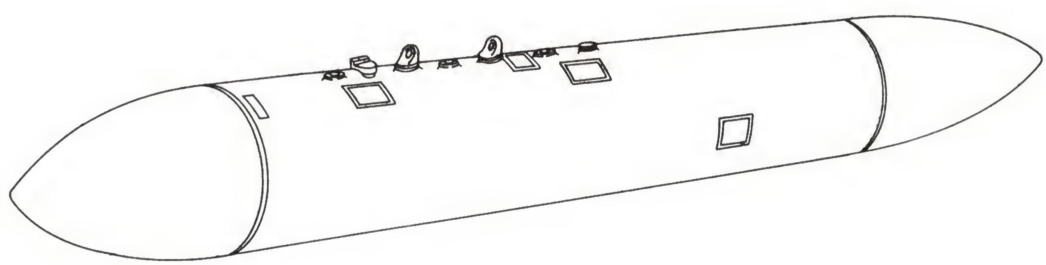


Figure 7-23. LAU-10/A Launcher, Airborne Configuration.

ınd locking rings removed), containing our assembled ZUNI rockets, and rangible fairings securely locked n place on each end of center section.

7-6.2.1 Ignition. Electrical power for he rocket ignition system is supplied o the launcher by the 28-volt DC rmament circuit of the aircraft. Electrical connection between the ircraft and launcher is made through either of two parallel AN 3107-14S-5P (five pin) receptacles, located n the vicinity of the launcher center section lugs. Pins A and B of the receptacles are positive connections o the aircraft. Pin E is the negative connection and is grounded to the auncher hanger beam which, in turn, s grounded to the aircraft through he suspension lugs. A selector switch is located in the aft bulkhead of the launcher for preflight selection of either ripple- or single-firing of he rockets. An intervalometer located in the forward bulkhead distributes the firing pulse to the individual rockets and is designed for a 95-millisecond time-delay nterval. Electrical connection to he motor is completed in each auncher tube through an ignition post on the detent latch to a contact band on the motor. The detent pawl is he grounding connection for the motor.

In addition to the selector switch n the launcher, some aircraft are equipped with a selector switch in the cockpit. In aircraft so equipped, the pilot has the in-flight option of either ripple- or single-firing, provided he selector switch in the launcher is n the proper position before takeoff. In aircraft equipped with the selector switch, there are two positive leads o the electrical receptacles in the auncher, one to pin A and one to pin B. In aircraft not equipped with a cockpit selector switch, the method of firing is restricted to preflight setting of the launcher selector switch. In these aircraft, there is only one positive lead, which is connected to pin A.

7-6.2.2 Launcher Selector Switch. The launcher selector switch, figure 7-24, is located in the aft bulkhead of the launcher. This switch has

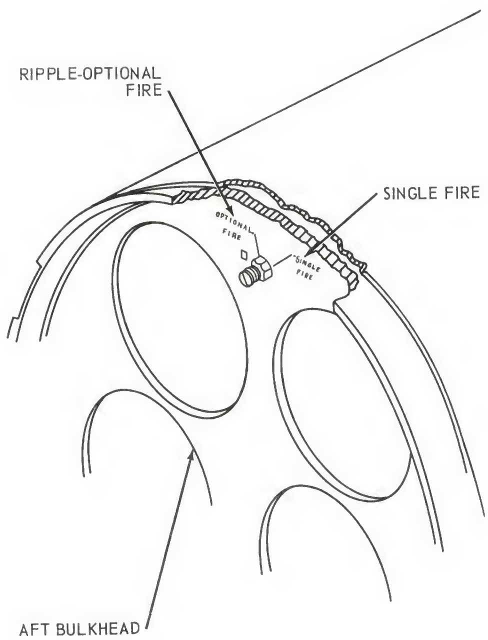


Figure 7-24. Launcher Selector Switch.

two settings, SINGLE and RIPPLE-OPTIONAL. When the launcher is used on an aircraft that does not have a pilot's selector switch, the method of firing must be determined before takeoff and the launcher selector switch set accordingly. In this case, if the selector switch is set on RIPPLE-OPTIONAL, the pilot is restricted to firing the rocket in ripple at 95-millisecond intervals controlled by the intervalometer. If the launcher is on an aircraft equipped with a pilot's selector switch, the launcher selector switch is set on RIPPLE-OPTIONAL. In this case, if the pilot selects RIPPLE-FIRE on his

selector switch, the ignition pulse goes to the launcher through pin A of the receptacle, through the launcher selector switch to the ripple-fire connection on the intervalometer, and ripple-fires the rockets. If the pilot selects SINGLE-FIRE on his selector switch, the ignition pulse goes to the launcher through pin B of the receptacle, bypasses the launcher selector switch, and goes to the single-fire connection on the intervalometer, single-firing the rockets at the pilot's discretion.

7-6.2.3 Intervalometer. The intervalometer, figure 7-25, is located in the forward bulkhead of the launcher. When single-fire is used, the intervalometer acts as a stepper switch and fires one rocket on each ignition pulse from the aircraft. If ripple-fire is used, the intervalometer converts the ignition pulse into a ripple rate with a 95-millisecond delay interval.

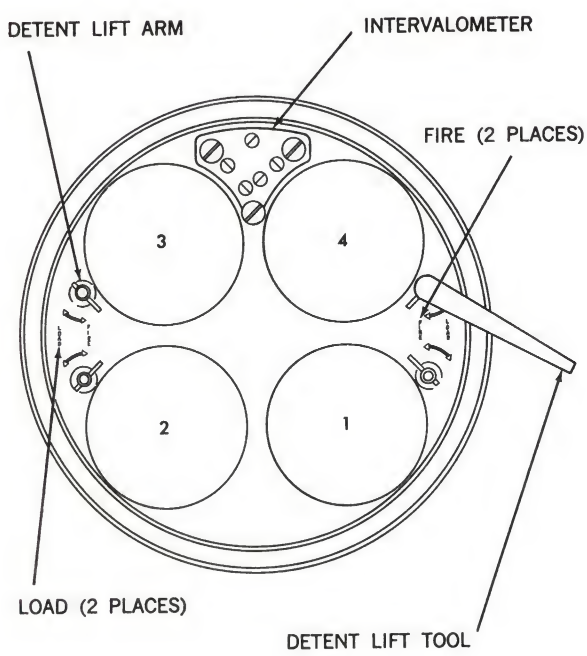


Figure 7-25. Launcher Forward Bulkhead, Showing Location of Intervalometer.

7-6.2.4 Frangible Fairings. The frangible fairings (see figure 7-23) will shatter readily from rocket impact or rocket blast. The fairing has a lugged metal base and a leaf-spring clip. The fairing base-band lugs engage grooves in the launcher center section end rings and, as the fairing is rotated clockwise, the leaf-spring clip drops into position to lock the fairing securely in place. The fairing fits flush with the outside surface of the center section to form an aerodynamically smooth joint.

7-6.2.5 Special Tools. The detent-lift tool (BuOrd dwg 55A27C100 or BuWeps dwg 1556962) (see figure 6-7) is used in conjunction with the LAU-10/A aircraft rocket launcher package.

7-6.3 LAU-10/A AIRCRAFT ROCKET LAUNCHER PACKAGE SPECIFICATIONS. The following are the specifications for the shippin configuration with motors and the airborne configuration with rockets:

Shipping Configuration, motors:
- Overall Length (in.) 97.9
- Cross Section (in.) . . . . 16 x 16
- Capacity (motors) 4
- Weight, empty (lb) 138
- Weight, loaded (lb) 375
- Fairing Container Capacity 6

Airborne Configuration, rockets:
- Overall Length (in.) 139
- Cross Section (in.) . . . . 13.9 (diame
- Capacity (rockets) 4
- Weight, empty (lb) 105
- Weight, loaded (lb) 533
- Suspension . . . . Multipl
- Ignition 28-volt
- Firing Rate
  - Ripple . . . . 95-mill second interva
  - Single . . . . Optiona
- Operating Temperature, Range, °F . . . . -65 to 1

7-6.4 PREPARATION OF NEW LAU-10/A LAUNCHERS FOR USE. When new LAU-10/A launchers containing motors are to be used, proceed as follows:

WARNING

The following steps must be conducted in a RADHAZ safe area.

1. Verify that the safety and arming device is in the SAFE position.

2. Break lockwires holding locking rings to ends.

3. Swing handles out. Latches should not be engaged when removing ring.

4. Rotate locking ring, with handles, in a counterclockwise direction until pins are disengaged from slots in shock pans, and remove ring.

5. Lift out end cover, tubular dunnage, and package which contains detent-lift tool and ignition post.

6. Remove detent-lift tool from package.

7. Raise all detents to LOAD position using detent-lift tool.

8. Push rocket motor forward.

9. Install shielding band in accordance with directions on the band as soon as the contact band clears the launcher. The shielding band does not touch the motor contact band, but covers it as a RADHAZ protection.

10. Remove motor and assemble warhead to motor as given in paragraph 6-3.2.

7-6.4.1 Suspending Launcher on Aircraft Before Loading. If time and space permit, the empty launcher may be suspended from the aircraft before rocket loading. Proceed as in paragraphs 7-6.5 and 7-6.5.1.

7-6.4.2 Loading Launchers Mounted on Aircraft. If the launcher is already on the aircraft, cut all power and place the launcher safety and arming device on the SAFE position. Proceed as instructed in paragraphs 7-6.5 and 7-6.5.1.

7-6.4.3 Ready-Service Stowage. If the launcher is being prepared for ready-service stowage, disconnect all power and place the arming and safety device in the SAFE position. Reinstall the safety and arming device or the dust cap, whichever is applicable, and proceed as in paragraphs 7-6.5 and 7-6.5.1.

7-6.5 PREPARATION OF FIRED LAU-10/A LAUNCHERS FOR ADDITIONAL ROCKET LOADING. The following steps may be performed while the launcher is on a workbench or while it is mounted on the aircraft. The shock pans may be left on the launcher or, in the case of a used launcher, may be replaced.

WARNING

Before performing the next steps, remove all rounds from the launcher.

1. Remove safety and arming device from receptacle that will be used to fire the launcher. For later model launchers, remove dust cap.

2. Place other safety and arming device in ARM position. When a safety switch is used, remove safety pin.

3. Lower detent to FIRE position.

4. Place mode switch, located at aft end of launcher, in RIPPLE-OPTIONAL position.

5. Secure ground wire from a 28-volt DC source to pin E or hanger lug.

6. Connect, between firing pin of launcher tube and ground, either a meter capable of reading 10 volts DC or an indicator light.

7. Apply 28 volts positive to pin A. (The intervalometer will ripple. Either the indicator light will flash or the meter will move slightly, indicating a pulse has traveled through the firing pin.) Break the circuit as soon as the intervalometer stops buzzing.

8. Repeat steps 6 and 7 until all four launcher tubes have been checked. (After each ripple, the intervalometer will home. When the test is completed, the intervalometer will be homed.)

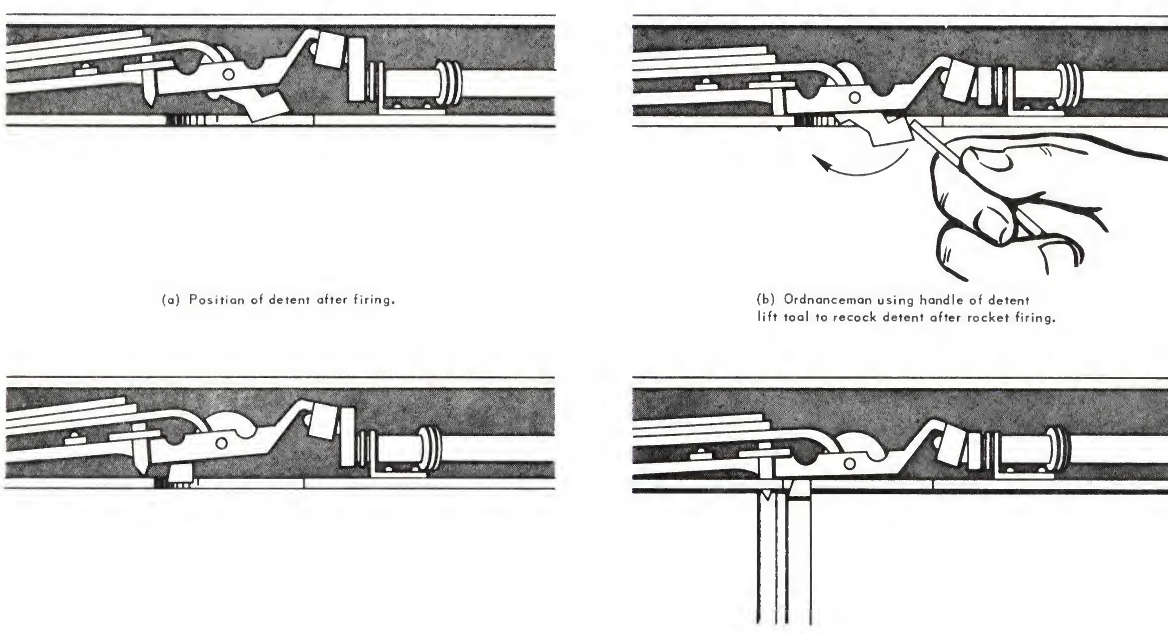
9. Secure launcher with safety and arming device in SAFE position.

7-6.5.1 Detent Procedure. The 5.0-inch FFAR (ZUNI) with its accompanying launcher is, in general, a very reliable combination, but im proper loading and improper detent are the greatest contributors to mi fires. Proper loading and detenting figure 7-26, are relatively simple, the following step-by-step procedu are followed. The detent pawl in the fired position and the detent lift device in the up position or LOAD position is illustrated in figure 7-2 In this position the indicator on the forward bulkhead points to LOAD. times, upon firing, the detent lift w not move fast enough to catch the d tent and hold it up.

WARNING

Detents must be properly positioned in order to fire rocket or to hold them in the launcher during rough handling.

1. Lower detent by turning deten lift to FIRE position, using detent-lift tool.



(a) Position of detent after firing.

(b) Ordnanceman using handle of detent lift tool to recock detent after rocket firing.

(c) Detent in position after being recocked.

(d) Detent and contact screw in proper groove of Zuni Rocket.

Figure 7-26. Procedure for Recocking Detent Pawl in ZUNI Launcher.

2. Reach inside launcher tube with detent-lift tool or small screwdriver and slip top of tool approximately 1/4 inch between pawl and forward end of slot in launcher tube, figure 7-26b.

3. Rotate detent pawl aft, using forward end of slot as a fulcrum. After starting the pawl, it may be pushed back with the thumb.

NOTE: The pawl will assume a definite stop as the detent springs engage and thus prevent the pawl from being turned by hand. The pawl may now be felt projecting into the tube at the aft end of the slot in the tube.

4. Perform the electrical checkout of the launcher as outlined in paragraph 7-6.5.

5. Raise detent to LOAD position with the detent-lift tool, figure 7-26c.

NOTE: The launcher is now ready to insert the rockets. Verify that the safety and arming device is in the SAFE position and that all power is OFF.

6. Insert aft end of assembled ZUNI rocket into forward end of launcher. Align fins to straddle aft stop in aft end of launcher tube. Push rocket SLOWLY into launcher tube.

WARNING

Never touch the contact band or remove the shielding band before loading the rocket into the launcher tube. Radio frequency energy may be present and could cause accidental ignition of the rocket motor. Slowly push rocket into launcher tube, do not jam it into tube.

7. Do not remove shielding band that covers motor contact band, but allow motion of rocket motor to push the shielding band off as motor enters launcher tube, figure 7-27. Continue to push slowly until nozzle plate of rocket motor comes in contact with aft stop in launcher tube.

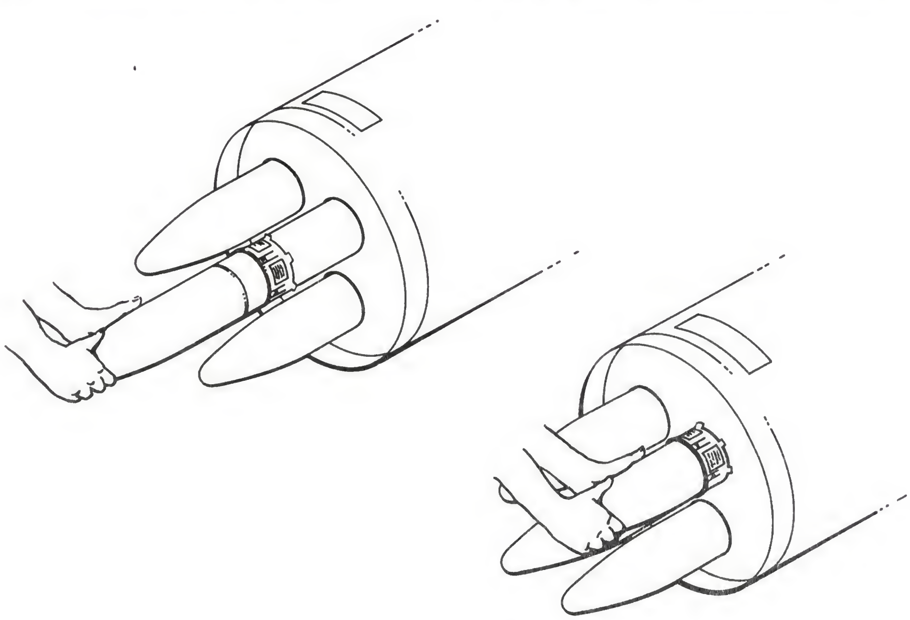


Figure 7-27. Automatic Removal of Shielding Band From Contact Band of Motor.

8. Using detent-lift tool, rotate detent-lift arm to FIRE position. The indicator will not turn completely to the FIRE position. At this point, the detent pawl is resting on the rocket motor, slightly forward of the detent groove.

9. Push forward hard on aft end of rocket until detent drops into detent groove. It will move ahead approximately 1/16 to 1/8 inch, and the pawl will engage the groove with an audible click which indicates positive engagement of the detent with the detent groove, figure 7-26d. With this action, the indicator will have turned farther toward the FIRE position.

> NOTE: Step 9 is more important than generally realized. The motor has to be pushed hard to make the detent drop into the detent groove. If it is not, the contact screw in the tube will not rest on the contact band of the motor and the rocket cannot be fired; also, the rocket will not be held securely in the launcher and may come out during rough handling or arrested landing.

7-6.5.2 Installing Launcher on Aircraft. To secure either a loaded or empty launcher on the aircraft, proceed as follows:

1. Remove safety and arming device or dust cap, whichever is applicable, from receptacle to be used to fire the launcher.

2. Verify that other safety and arming device is on SAFE position.

3. For use with Aero 15 bomb racks only, install ignition post (see figure 6-8) in forward receptacle; align it as indicated on post.

4. Adjust lugs that are to be usec on launcher. Remove lugs which ar not to be used.

5. Following bomb rack instructi prepare bomb rack to receive launc

6. If launcher is already loaded, lease clips holding handles of lockir ring and swing out until clips lock into shock pans.

7. Raise launcher into position or bomb rack, guide ignition post into slot, and latch rack in accordance with bomb rack instructions.

8. Remove shock pans and lockin rings.

9. Tighten sway braces securely (approximately 125 inch-pounds).

A slight depression of the skin is to be expected as the skin is loose ove the launcher strongback.

10. Set firing mode switch to desired position.

7-6.5.3 Installing Fairings. To install the frangible fairings on the launcher, proceed as follows:

1. Align arrows on fairings with arrows on launcher.

2. Raise fairing lock spring.

3. Push fairing onto launcher as far as it will go and rotate it clockwise.

4. Verify that fairing lock spring has dropped back into place.

7-6.5.4 Procedure Before Takeoff. Before takeoff, proceed in the follov manner:

1. Perform stray voltage test following instructions for such tests

2. Lower striker arm in Aero 15 series bomb racks, or plug in umbilical cable, whichever is applicabl

3. Move safety and arming device o ARM, or remove safety pin and lag, whichever is applicable.

-6.6 DISARMING LAUNCHER. Move ircraft to the disarming area, proeed as follows:

1. Move safety and arming device o SAFE position, or install safety in, as applicable.

2. Raise striker arm, or disconnect mbilical cable, as applicable.

-6.7 REMOVING LOADED AUNCHER. To remove a loaded auncher from an aircraft, proceed s follows:

1. Disarm launcher as described n paragraph 7-6.6.

2. Remove fairings by lifting fairing ock and rotating fairings counterlockwise.

3. Install shock pans and locking ing by locking handles in outboard osition.

WARNING

Do not drop the launcher when removing it.

4. Release rack and lower launcher o deck.

5. If no attempt was made to fire he rockets, return the launcher to eady-service stowage.

-6.8 UNLOADING LAUNCHER. When emoving rounds from the launcher, roceed in the following manner:

1. Raise detents to LOAD position.

2. Begin moving shielding band ver warhead by pushing forward on he round until lugs on shielding and drop into the detent grooves of orward bulkhead.

3. Remove rocket and move to nagazine.

7-6.9 CAUSES OF MISFIRES. The LAU-10/A launchers loaded with ZUNI rockets are generally a reliable combination. The greatest single incident contributing to misfires is improper detenting. Another is the use of several launchers on the same aircraft simultaneously which can result in aircraft power being too widely distributed to supply sufficient current for an individual launcher fireout. Most aircraft cannot fire more than two launchers simultaneously.

7-6.9.1 Causes for Partial Fireouts—Ripple Fire. The firing order from the aft end of the launcher is shown in figure 7-28. With the launcher

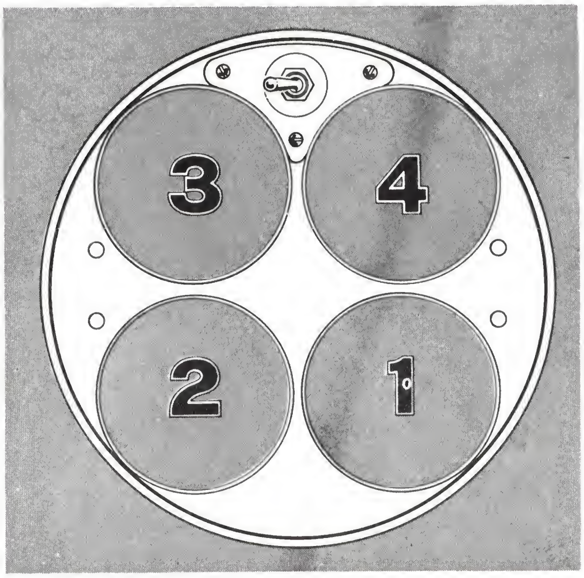


Figure 7-28. Firing Order From Aft End of Launcher.

set for RIPPLE fire, there are several reasons for partial fireout as follows:

1. If round number 1 remained and rounds 2, 3, and 4 fired, or if rounds 1 and 2 remained and rounds 3 and 4 fired, or if rounds 1, 2, and 3 remained and round 4 fired, the intervalometer was not homed properly. A second

pulse would have fired the remaining rounds.

2. If rounds 1, 2, and 3 fired, but round 4 remained, the firing pulse was probably not long enough (about 325 milliseconds is the minimum firing time).

3. If there was an irregular fireout pattern, either the rounds were not properly detented or there were loose connections in the electrical circuit of the aircraft or the launcher. The launcher should be unloaded and checked.

7-6.9.2 Causes for Partial Fireouts—Single Fire. With the launcher set on SINGLE fire, the following reasons could result in partial fireout:

1. The rockets were not properly detented.

2. There were loose connections in the electrical circuit.

3. The electrical pulses were not completely clipped, resulting in an inability to fire a second round.

7-6.9.3 Causes for Complete Misfires. If no rounds leave the launcher, either one or a combination of the following could be the cause:

1. There was insufficient power from the aircraft. At least 5 amperes is required at the striker arm or umbilical using aircraft power.

2. The safety and arming device was not in ARM position. For this type of malfunction, check the aircraft for blown fuses or circuit breakers.

3. The rounds were improperly detented. Again check the aircraft for blown fuses or circuit breakers.

4. Possibly, the intervalometer failed.

7-7 LAU-33/A AND LAU-35/A AIRCRAFT ROCKET LAUNCHER PACKAGES

The LAU-33/A and LAU-35/A launchers are reusable units, each designed to fire two 5.0-inch ZUNI rockets. They are suitable for air-to-air or air-to-ground rocket launching and are compatible with F-8 series jet aircraft. These launchers can be attached to AIM-9 guided missile launchers (either Aero 3A or LAU-7/A). An aircraft equipped with two Aero 3A guided missile launchers can accommodate two LAU-33/A launchers—a total load of four ZUNI rockets. An aircraft with dual pylons and four LAU-7/A guided missile launchers can accommodate three LAU-33/A and one LAU-35/A launchers—a total load of eight ZUNI rockets.

The launchers consist of two tubes with internal framework for support. Three hangers secured to the framework are used to attach the LAU-33/A or 35/A launcher to the guided missile launcher. The hangers are the same size and shape and fit the hangers of the Aero 3A and LAU-7/A launchers, figure 7-29.

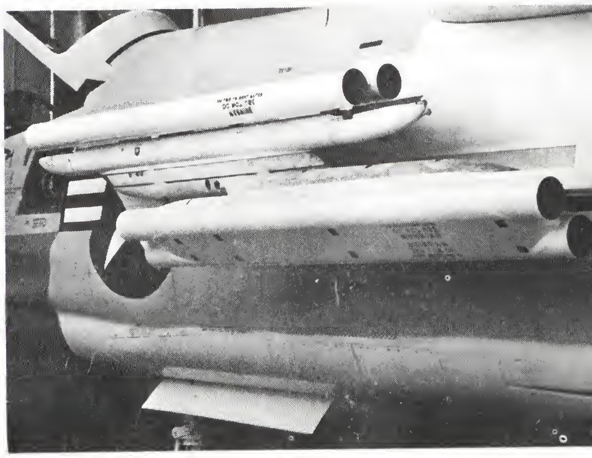


Figure 7-29. LAU-33/A on LAU-7/A Launcher Mounted on F-8 Jet Aircraft.

NOTE: The LAU-35/A launcher is to be used on the lower left-hand dual station only. All other stations require LAU-33/A launchers.

7-7.1 LAU-33/A AND LAU-35/A AIRCRAFT ROCKET LAUNCHER SPECIFICATIONS. The following are the specifications for both the LAU-33/A and LAU-35/A launchers. No fairings are used on these launchers:

Length (in.)	93 5/8
Width (in.)	12 5/16
Height (in.)	6 1/4
Empty Weight (lb)	40
Airborne Weight (lb)	254

7-7.2 INSTALLING ROCKET LAUNCHER TO AERO 3A OR LAU-7/A LAUNCHER. The following procedure is to be used for the installation of the 2-round rocket launcher on the guided missile launcher on F-8 aircraft:

1. Raise Aero 3A or LAU-7/A missile launcher forward detent by actuating snubber latch pivot with 3/8-inch Allen wrench. On the LAU-7/A launcher, also release aft detent by lifting aft latch handle.

2. Insert rocket launcher hangers into missile launcher rail slots and slide forward until the launcher detent slips into the loading slot in the missile launcher rail.

NOTE: If the Aero 3A missile launcher has the AIM-9C unloading stirrup or the LAU-7/A missile launcher has a blast deflector installed, load the rocket launcher forward hanger first. Push forward and bring center and aft hangers into the rail, as the center and aft hangers align with rail cutouts.

3. Insert safety pin.

4. Lower forward detent. On LAU-7/A missile launcher, also engage aft detent.

5. Make sure forward detent is lowered and has secured rocket launcher forward hanger.

NOTE: On new launchers, electrical ground setscrews in the launcher rail may drag on the rocket launcher hangers. Push firmly over screws.

6. Connect umbilical, figure 7-30, to launcher. If rocket launcher is installed on LAU-7/A missile launcher, use adapter plug (FSN-VM-5935-885-9397-M558) between rocket launcher and missile launcher electrical connectors.

7. Verify that only LAU-35/A rocket launcher is installed on lower left-hand missile launcher.

8. Verify that LAU-33/A and LAU-35/A rocket launcher detent is engaged in loading slot of Aero 3A or LAU-7/A guided missile launcher, and that safety pin is in place.

9. Verify that electrical connectors are secured.

7-7.3 ELECTRICAL CHECKOUT OF LAUNCHER. For proper cockpit switching, consult the appropriate handbook.

1. Verify that no rockets are in launcher.

2. Set selector switch on RIPPLE position.

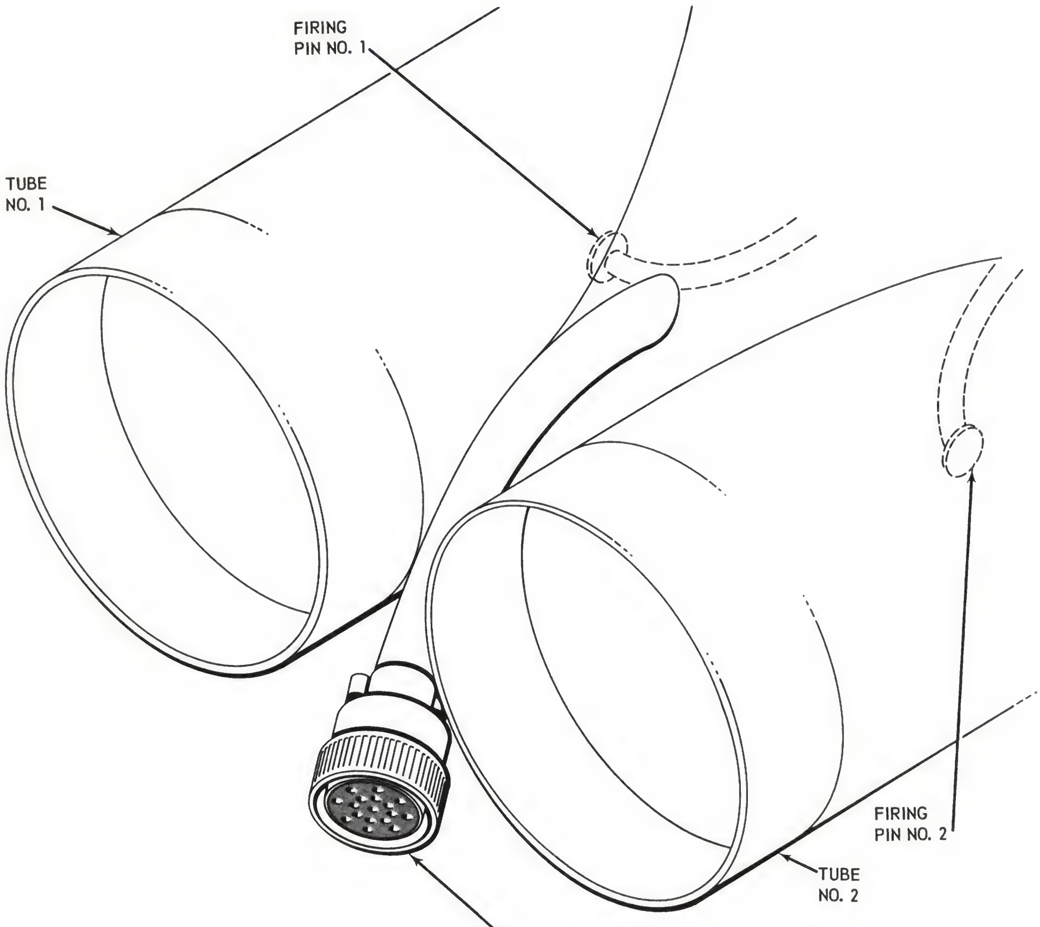


Figure 7-30. Use of Umbilical and Launcher Adapter Plug.

3. Lower detents to FIRE position, using detent-lift tool (CV 21-206133-1), figure 7-31.

4. Connect voltmeter or test light between contact screw in launcher and ground.

5. Remove safety pin from safety switch, figure 7-32.

6. Depress rocket firing switch and apply current to launcher. Two pulses should be indicated on meter or by light. The light will flash twice, or the hand of the voltmeter will move twice.

7. Repeat steps 1 through 6 on remaining launcher tubes. The in valometer will be homed automati after each pulse.

8. Replace safety pin.

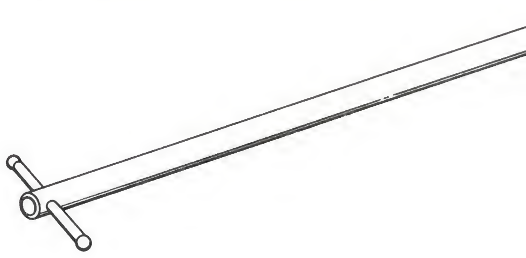


Figure 7-31. Detent-Lift Tool for Use on LAU-33/A or LAU-35/A Launchers.

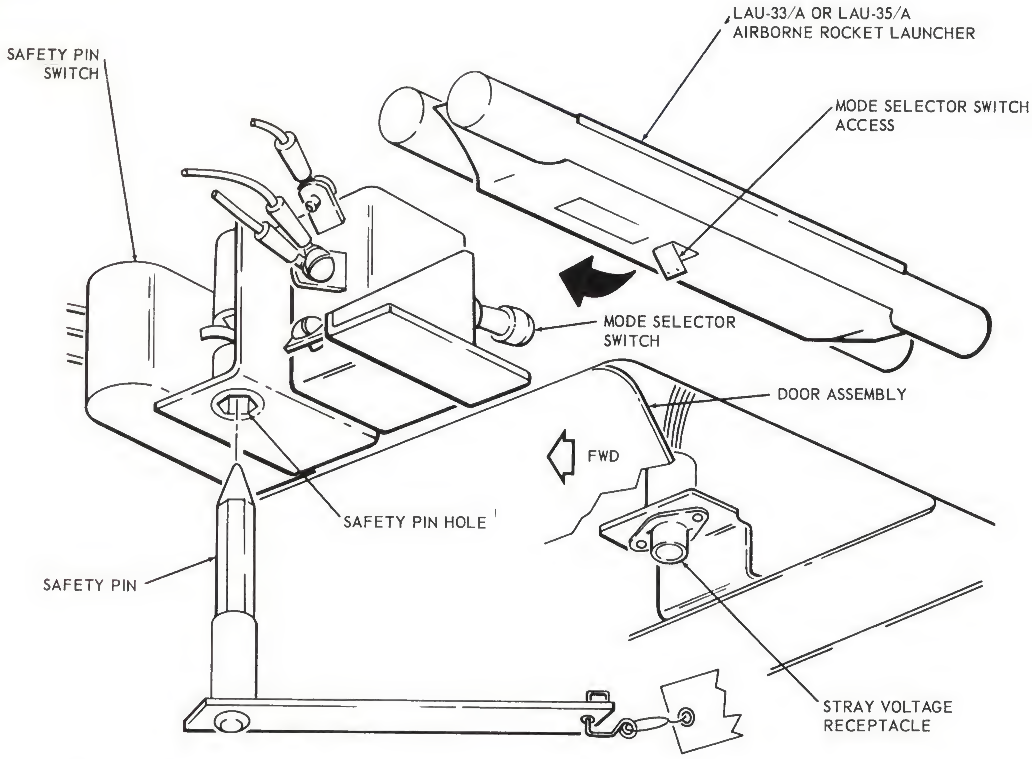


Figure 7-32. Safety Pin Location of LAU-33/A and LAU-35/A Launchers.

7-7.4 LOADING ROCKETS IN LAUNCHER. Proceed in the following manner when loading the launcher.

1. Disconnect all external power.

WARNING

Safety pin installed in Aero 3A missile launcher does not interrupt firing circuits of LAU-33/A or LAU-35/A launchers. Rocket firing circuits are safe only after safety pin (BuOrd 58A164C165) has been inserted in the rocket launcher. Safety pins that do not have a ball-lock shall not be used, because without the ball retention the pins might fall out.

2. Install safety pin in safety switch of LAU-33/A or LAU-35/A launcher.

3. For detenting and rocket loading procedure, follow step-by-step procedures given in paragraph 7-6.5.

7-7.5. ARMING LAUNCHER. When arming the launcher, proceed in the following manner:

1. Check for stray voltage in launcher, using stray voltage jack located behind access door in side of launcher.

2. Set firing control mode selector switch in RIPPLE or SINGLE fire as required by the mission.

3. Close and secure access door.

4. Pull safety pin from safety switch prior to takeoff.

7-7.6 DISARMING LAUNCHER. The following procedure shall be used when disarming the launcher:

WARNING

Safety pins installed in Aero 3A missile launchers do not interrupt LAU-33/A or LAU-35/A rocket launcher firing circuits. Rocket launcher firing circuits are safe only after insertion of safety pins (BuOrd 58A64C165) in rocket launcher. Safety pins that do not have a ball-lock shall not be used, because without the ball retention the pins might fall out.

1. Insert safety pin in safety switch immediately upon landing.

2. Point aircraft in direction approved by safety officer or move to the unloading area.

3. Raise detent to LOAD position.

4. Push rocket forward; and, as the rocket emerges from the launcher, install contact shielding band. It will catch in the detent groove and cover the contact band (see figure 7-27a and b).

5. Dispose of rockets in accordance with current directives.

7-7.7 REMOVING ROCKET LAUNCHER FROM GUIDED MISSILE LAUNCHER.

Proceed in the following manner when removing the LAU-33/A or LAU-35/A rocket launchers from the Aero 3A or LAU-7/A guided missile launcher:

1. Open missile launcher nose cover.

2. Disconnect umbilical (see figure 7-30). If rocket launcher is installed on LAU-7/A missile launcher, remove adapter plug (see figure 7-30).

3. On Aero 3A launcher, raise forward detent by actuating snubber lat pivot at side of launcher with 3/8-inc Allen wrench. On LAU-7/A missile launcher, raise forward detent and snubber by turning safety pin in latch pivot located behind door; also release aft detent by lifting aft latch handle.

4. Remove safety pin from launch detent and pull the detent out of the loading slot of missile launcher rail.

5. Support rocket launcher and slide aft until hangers are opposite slots in missile launcher rails, then lower hangers through slots.

6. Close missile launcher nose cover.

7-7.8 CAUSES OF MISFIRES. The ZUNI rocket used in combination wit the LAU-33/A and LAU-35/A launch are generally quite reliable. Howeve malfunctions do occur occasionally with the following causes contributin most frequently:

1. Failure to detent rockets properly.

2. Failure to home the intervalometer.

3. Failure to set the selector switch in the proper position.

Appendix A
OBSOLESCENT COMPONENTS AND ASSEMBLIES

Obsolescent rounds are treated in this appendix. These rounds are still capable of use, but they have been replaced by improved designs. Also included are items with a tactical purpose which is no longer important.

See OD 17190 "Restricted and Unserviceable Ammunition" for assemblies and components which have been declared obsolete.

A-1 2.25-INCH ROCKET WARHEAD MK 3 ALL MODS (PRAC, SC)

These warheads, figures A-1 and A-2, are for the practice, subcaliber rounds which simulate the trajectory of the 5.0-inch HVAR.

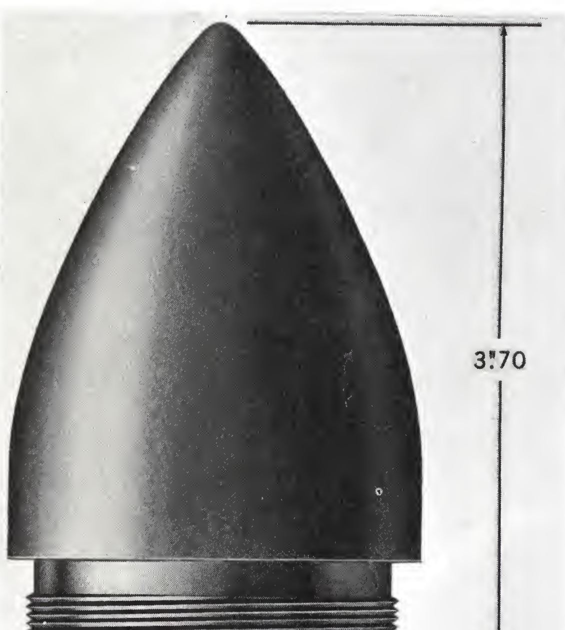


Figure A-1. 2.25-Inch Rocket Head Mk 3 Mod 3 (PRAC, SC), External View.

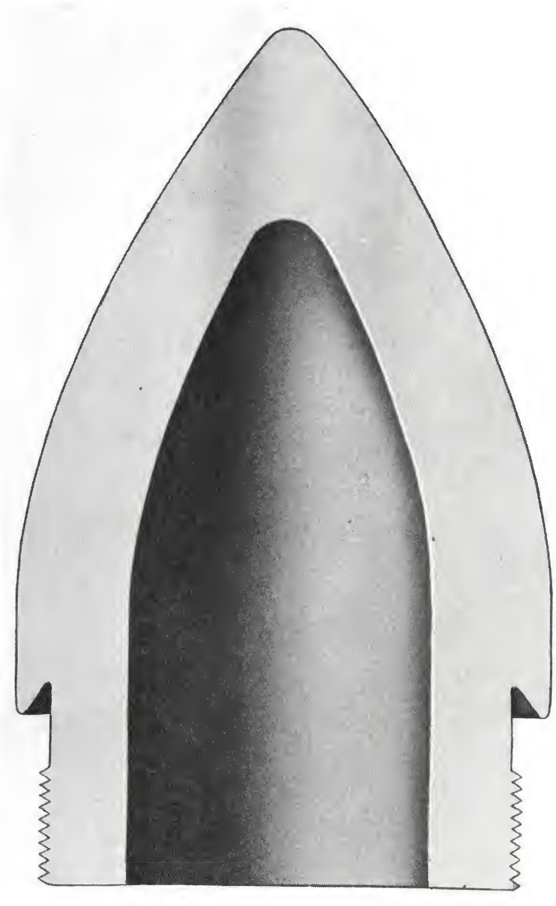


Figure A-2. 2.25-Inch Rocket Head Mk 3 Mod 3 (PRAC, SC), Cross Section.

Mark	3	3	3
Mod	0	2	3
Lot No. Prefix	None	None	N
List of Drawings	None	175447	N
Loading Assembly No.	424977	439208	43
Overall Shipping Length (in.)	3.75	3.75	3.
Length Without Details (in.)	3.75	3.75	3.
Nominal Weight Shipped (lb)	1.60	1.60	1.
Nominal Weight Fired (lb)	1.60	1.60	1.
Filler	None	Plaster	N
Container Mk-Mod	2-0	2-0	2-

Mod 0 is made of steel. It has no ndercut at the aft end of the ogive uch as is found on the Mods 2 and 3. The head also is assembled in dummy ounds. Mod 3 is made of cast iron.

The differences in the mods of this varhead are as follows:

1. Mod 1 is of one-piece, forged onstruction and has no fuze cavity iner.

2. Mod 3 is cold-formed and has no fuze cavity liner.

3. Mod 4 is made of two pieces brazed together (near the bourrelet). t has a fuze cavity liner.

4. Mod 5 is similar to the Mod 4, except that the base is formed by stamping instead of forging.

Any of these mods may be loaded with an inert filler instead of HBX-1 o become a practice head. A steel nose plug is assembled in practice warheads in place of the nose fuze. Inert loaded warheads do not require fuze cavity liners, although some do have them.

A-2 2.25-INCH ROCKET MOTOR MK 15 MODS 0 AND 2

This motor, figures A-3 and A-4, is used for practice, subcaliber rounds.

The Mod 0 motor tube is seamless and the Mod 2 motor tube is electrically welded. The two lower fins, farthest from the suspension buttons, each have two slits near their inboard trailing edge. The metal between these 1-inch-long slits is bent over the cable of the electrical connector to secure the cable to the rocket. Securing the cable to the rocket in this fashion prevents the nozzle-closure end of the cable from striking the wing of the plane when the rocket is fired.

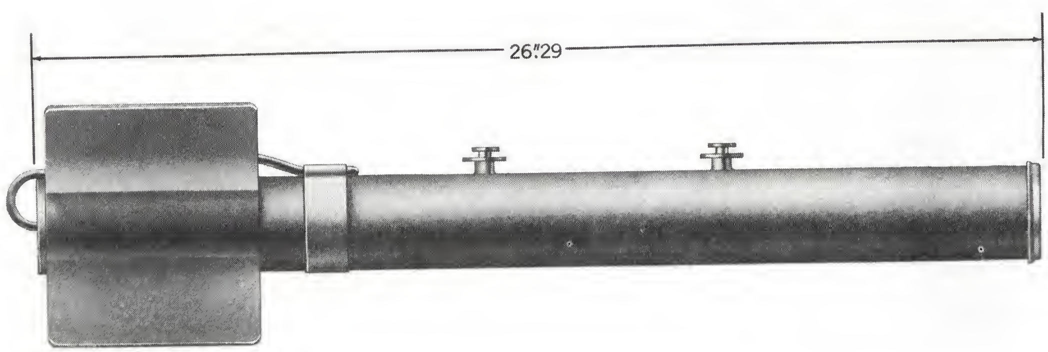


Figure A-3. 2.25-Inch Rocket Motor Mk 15 Mod 2, External View.

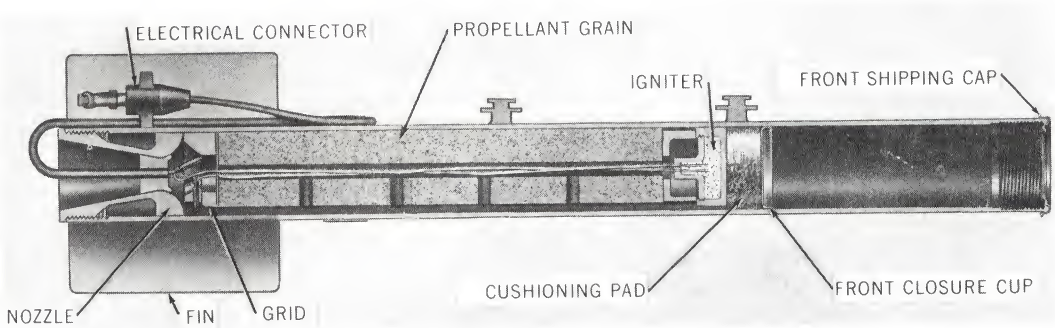


Figure A-4. 2.25-Inch Rocket Motor Mk 15 Mod 2, Cross Section.

Mark	15	15
Mod	0	2
Loading Assembly No.	656221	656222
List of Drawings	174694	174695
Lot No. Prefix	RMBF	RMBF
Type Stabilization	Fin	Fin
Nominal Weight Shipped (lb)	10.90	10.90
Nominal Weight Fired (lb)	10.87	10.87
Thrust (lb)	710	710
Overall Shipping Length (in.)	26.29	26.29
Length Without Details (in.)	26.19	26.19
Fin Diameter (in.)	8.30	8.30
Distance between Lugs (in.)	6.0	6.0
Burning Time (sec)	0.54	0.54
Propellant Grain Mk-Mod	16-1	16-1
Igniter Mk-Mod	112-0, 1, or 2	112-0, 1, or 2
Electrical Connector:		
Mk-Mod	12-2	12-2
Length of Cable (in.)	30.5	30.5
Container Mk-Mod	2-0	2-0

A-3 2.25-INCH ROCKET MOTOR MK 16 MODS 4 AND 6

This motor, figures A-5 and A-6, is also used for practice, subcaliber rounds.

The motor tube of the Mod 4 is seamless and the motor tube of the Mod 6 is electrically welded. The two lower fins, those farthest from the suspension buttons, each have two slits near their inboard trailing edge. The metal between these 1-inc long slits is bent over the cable of the electrical connector to secure the cable to the rocket. Securing the cable to the rocket in this fashion prevents the nozzle-closure end of the cable from striking the wing of the plane when the rocket is fired.

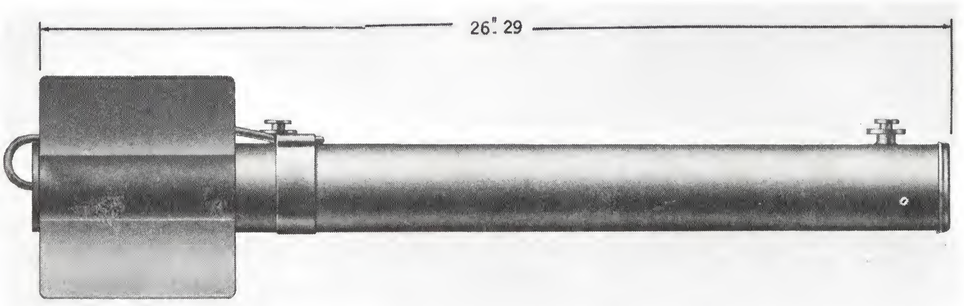


Figure A-5. 2.25-Inch Rocket Motor Mk 16 Mod 6, External View.

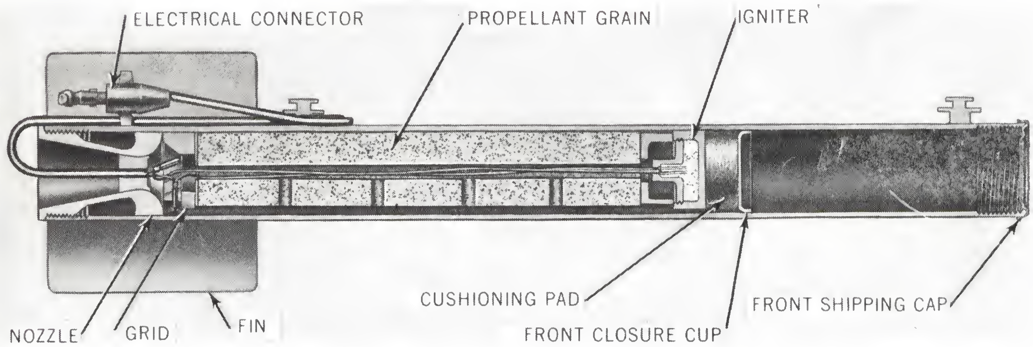


Figure A-6. 2.25-Inch Rocket Motor Mk 16 Mod 6, Cross Section.

Mark	16	16
Mod	4	6
Loading Assembly No.	656767	656832
List of Drawings	268477	268483
Lot No. Prefix	RMBF	RMBF
Type Stabilization	Fin	Fin
Nominal Weight Shipped (lb)	10.89	10.89
Nominal Weight Fired (lb)	10.86	10.86
Thrust (lb)	710	710
Overall Shipping Length (in.)	26.29	26.29
Length Without Details (in.)	26.19	26.19
Fin Diameter (in.)	8.30	8.30
Distance between Lugs (in.)	18.50	18.50
Burning Time (sec)	0.54	0.54
Propellant Grain Mk-Mod	16-1	16-1
Igniter Mk-Mod	112-0, 1, or 2	112-0, 1, or 2
Electrical Connector:		
Mk-Mod	10-4	10-4
Length of Cable (in.)	18.65	18.65
Container Mk-Mod	2-0	2-0

A-4 2.25-INCH ROCKET MK 4 MOD 0 (SCAR)

The 2.25-Inch Rocket Mk 4 Mod 0, figure A-7, simulates trajectories of the 5.0-Inch HVAR.

The Mk 5 Mod 0 dummy round is used for drill. It is exactly like the Mk 4 Mod 0, except that it uses an inert-loaded 2.25-Inch Rocket Motor Mk 15 all Mods.

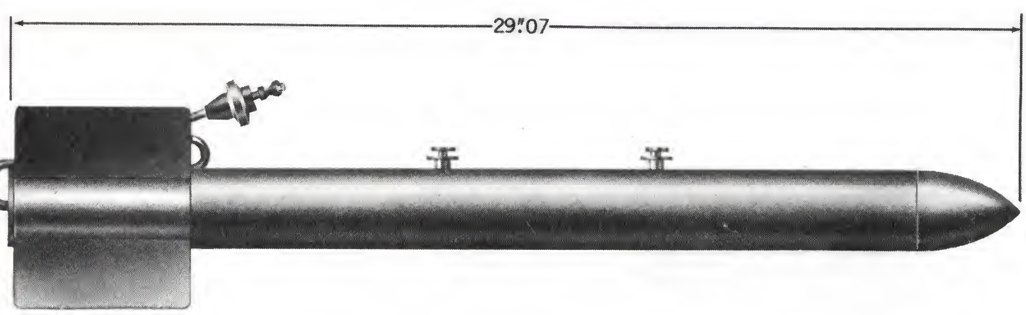


Figure A-7. 2.25-Inch Rocket Mk 4 Mod 0 (SCAR), External View.

Mark	4
Mod	0
Nominal Velocity (fps)	1110
Nominal Weight (lb)	12.47
Overall Length (in.)	29.07
Head, 2.25-Inch, Mk-Mod	3-0 or 2
Motor, 2.25-Inch, Mk-Mod	15-0, 2, or 3
Nose Fuze Mk-Mod	None
Base Fuze Mk-Mod	None
Time to 1000 yd (sec) (Temperature at 70° F)	3.2
C.G., Before Burning (in.) (Measured from rear)	12.85
Trajectory Table in OP No.	1829
Container Mk-Mod	2-0

A-5 2.25-INCH ROCKET MK 6 MOD 0 (SCAR)

This round, figure A-8, also simulates trajectories of the 5.0-Inch HVAR.

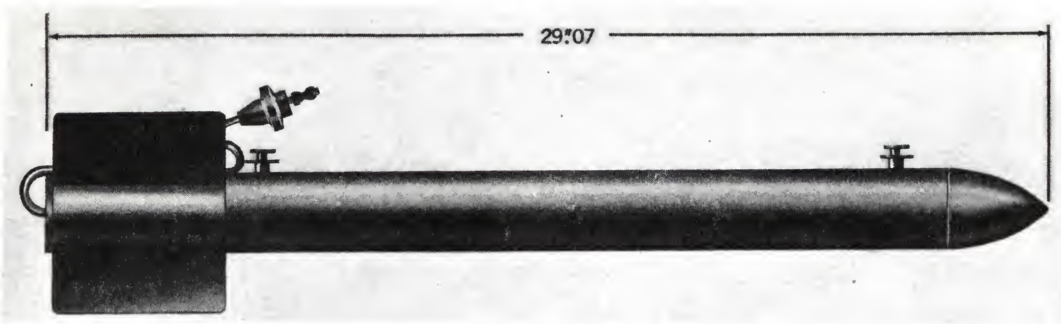


Figure A-8. 2.25-Inch Rocket Mk 6 Mod 0 (SCAR), External View.

Mark	6
Mod	0
Nominal Velocity (fps)	1110
Nominal Weight (lb)	12.46
Overall Length (in.)	29.07
Head, 2.25-Inch, Mk-Mod	3-0, 2, or 3
Motor, 2.25-Inch, Mk-Mod	16-4, 5, or 6
Nose Fuze Mk-Mod	None
Base Fuze Mk-Mod	None
Time to 1000 yd (sec) (Temperature at 70° F)	3.2
C.G., Before Burning (in.) (Measured from rear)	12.85
Trajectory Table in OP No.	1829
Container Mk-Mod	2-0

A-6 2.25-INCH SUBCALIBER PRACTICE ROCKET ASSEMBLY PROCEDURES

After the rocket components have been removed from their containers and inspected, assemble as follows:

1. Remove front shipping caps from motor.

2. Lute threads of both warhead and motor with a suitable luting compound, such as Crate compound, or red or white lead of such consistency that it can be applied with a brush.

3. Thread head into motor as tightly as possible, using a pipe wrench on head and a strap wrench ONLY on motor, figure A-9.

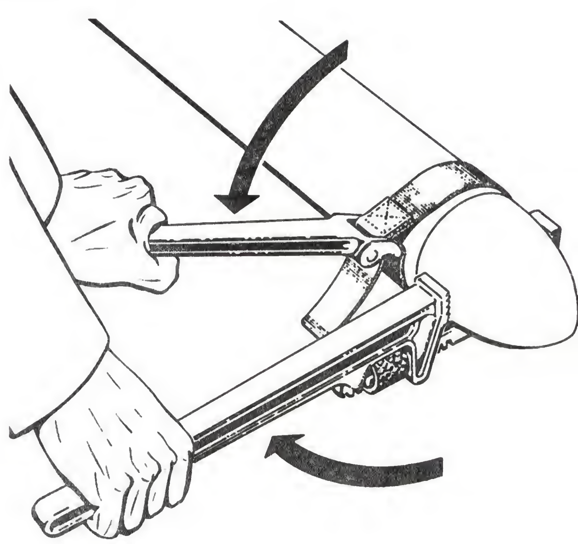


Figure A-9. Assembling Head and Motor of 2.25-Inch SCAR Rocket.

4. Place cable of electrical connector across inboard side of outboard (in relation to plane fuselage) slit fin, figure A-10.

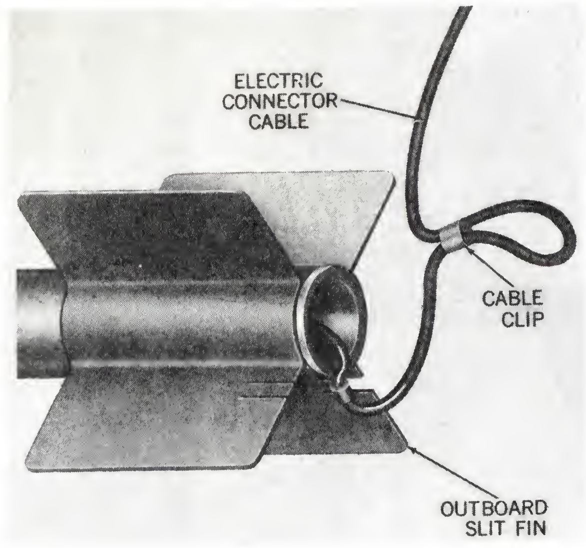


Figure A-10. Electrical Connector Cable Snubbed to Fin of 2.25-Inch Rocket.

5. Bend the 3/8-inch strip of metal, between the slits, lightly over the cable.

6. Remove all slack in cable between the nozzle and slit fin.

7. Secure cable to slit fin by bending the strip tightly over the cable. Take care to avoid bending any other part of this fin or the other fins.

NOTE: The clip which forms the loop in the cable may be removed, if necessary, to lengthen the cable and make it fit certain launchers. Otherwise, leave this clip on the cable because it prevents the cable from whipping around in the airstream. This whipping action might loosen one of the connections or damage the wing surface of the aircraft.

8. See that shorting clip is in place on electrical connector plug.

NOTE: Because of the inherent weakness of the locking pins of die-cast, jack type electrical connector plugs (BuOrd dwg 454642), the plugs would become disconnected from their receptacles during flight, causing a dud. Since some of these rocket motors are still in stock, and until such time as rocket motors with new electrical connectors are available, it is recommended that a retaining ring, figure A-11, be fabricated from seamless steel aluminum, or any other metallic tubing of appropriate inside diameter to meet the requirements.

9. Check electrical connector plug and inert retainer ring if required.

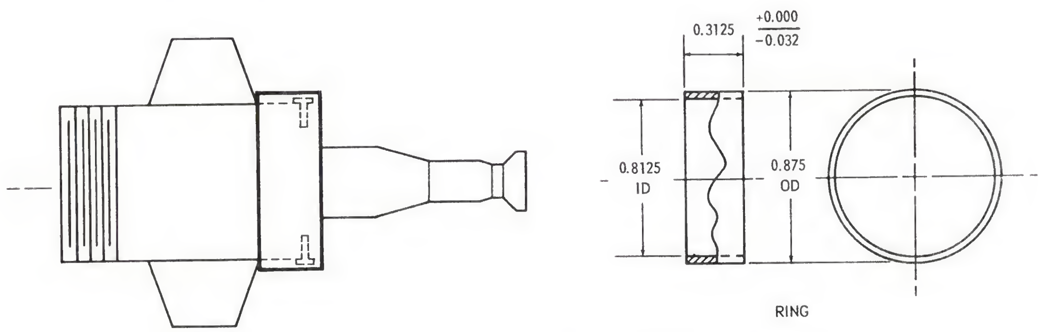


Figure A-11. Complete Assembly With Ring Attached.

A-7 2.25-INCH SUBCALIBER PRACTICE ROCKET DISASSEMBLY PROCEDURES

Inspect the round for defects before disassembling as follows:

1. Be sure that shorting clip is in place on electrical connector plug.

2. Unscrew warhead from motor, using pipe wrench on head and strap wrench on motor.

3. Wipe luting compound from the threads of head and motor, using an approved solvent.

4. Replace front shipping cap on motor.

5. Return head and motor to their containers.

A-8 3.0-INCH ROCKET MK 15 MODS 0 AND 1 (AIRCRAFT, NIGHT DRIFT SIGNAL, RETRO-300 FPS)

This rocket-powered pyrotechnical signal, figure A-12, is retrofired at 300 fps from patrol aircraft to mark a target. Firing of the rocket initiates the delay firing mechanism of the drift signal.

After the rocket motor propellant burns out, the motor is jettisoned from the signal by action of a spring and the signal falls into the sea. The firing mechanism activates the signal.

A-8.1 DESCRIPTION. The 1.25-Inch Rocket Motor Mk 2 all Mods has a single nozzle and a cylindrical, radially perforated propellant grain. A desiccant bag is assembled in the nozzle and secured by the nozzle seal. The Mod 1 differs from the Mod 0 since the Mod 1 has an Army-Navy-type, two-prong electrical connector plug while the Mod 0 has a standard household-type, two-prong electrical connector plug.

The connector assembly of the rocket motor joins the motor to the drift signal, initiates the drift signal, and jettisons the motor when the rocket propellant has burned out. The connector assembly consists of a cap, sleeve, spring, shear pin, and safety pin (see figure A-12).

The cap has female threads at one end which mate with male threads in the rocket motor tube. At the other end of the cap, a shaft is held in the sleeve by the safety and shear pins. The sleeve has male threads which secure it to the drift signal.

When the safety pin has been removed and the rocket fired, the shaft in the connector assembly is driven toward the signal, breaking the shear pin. This compresses the connector spring; it also overcomes the spring under the firing pin in the signal. The firing pin is driven into the primer of the signal, initiating the delay fuze.

After the propellant burns out in the rocket motor, ending its thrust against the signal, the compressed spring of the connector pushes the

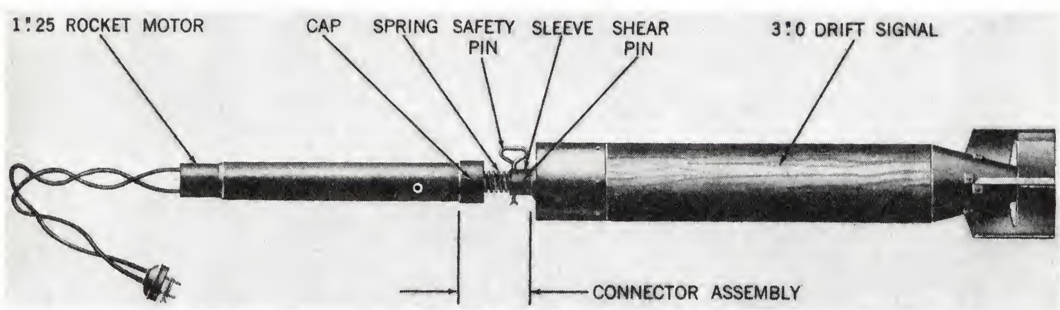


Figure A-12. 3.0-Inch Rocket Mk 15 Mod 1 (Aircraft, Night Drift Signal, RETRO-300 fps).

Mark	15
Mod (Mods differ only in the electrical connector.)	0 and 1
General Arrangement	375030
List of Drawings	108811
Nominal Weight (lb)	4.80
Overall Length (in.)	32.46
Night Drift Signal, AN-Mk-Mod	5-4
General Arrangement	982534
List of Drawings	256089
Weight (lb) (approx)	3
Delay (sec)	8 to 12
Burning Time (min) (approx)	12
Smoke Color	White
Motor, 1.25-Inch, Mk-Mod (Mods differ only in the electrical connector.)	2-0 and 1
Loading Assembly No.	375026
List of Drawings	108664
Lot No. Prefix:	
Mod 0	RMAB
Mod 1	RMAE
Nominal Weight Shipped (lb)	1.80
Nominal Weight Fired (lb)	1.80
Thrust (lb)	270
Overall Shipping Length (in.)	13.47
Length Without Details (in.)	13.47
Burning Time (sec)	0.16
Propellant Grain Mk-Mod	4-1
Igniter Mk-Mod	105-0 or 1
Electrical Connector Type:	
Mod 0	Household
Mod 1	Army-Navy
Container Mk-Mod	2-0 or 1

cap out of the sleeve. This separates the rocket motor from the signal.

Night Drift Signal AN-Mk 5 Mod 4 produces light and smoke. The signal consists of a die-cast nose, wood body, and sheet metal tail. The nose contains a spring-held firing pin and a primer. The body is a wood cylinder with a hole in the center, in which are three pyrotechnic pellets in a moisture-proof tube.

A delay fuze connects the primer, through a hole in the center of the pyrotechnic pellets, to the firstfire quickmatch at the tail end of the signal. A capped hole leads from the pyrotechnic pellets to the tail end.

When the rocket is fired, the cap of the connector assembly is driven against the firing pin. The firing pin initiates the primer which, in turn, initiates the delay fuze. The delay fuze burns for 8 to 12 seconds before it ignites the firstfire quickmatch.

Burning of the quickmatch ignites the pyrotechnic pellets. The increase in pressure inside the signal blows the cap from the tail opening, allowing the flame and smoke to flow from the signal. It floats tail-end up.

A-8.2 ASSEMBLY PROCEDURES. In assembling this rocket, proceed as follows:

1. Screw motor tube into female threads of connector assembly cap.

2. Unscrew retaining nut from nose of drift signal and remove sealing disc. Do not touch firing pin.

3. Screw assembled rocket motor and connector into head of drift signal. Do not remove the safety pin or shear pin of the connector.

A-8.3 DISASSEMBLY PROCEDURES. In disassembling this rocket, proceed as follows:

1. See that short-circuiting wire is in place on plug of electrical connector.

2. Be sure that safety pin and shear pin are in place on connector assembly.

3. Unscrew connector sleeve from head of drift signal.

4. Replace sealing disc in cavity of signal.

5. Replace retaining nut on nose of signal and return signal to its containe

6. Return rocket motor and connector assembly to containers.

A-9 3.0-INCH ROCKET MK 16 MODS 0 AND 1 (AIRCRAFT, NIGHT DRIFT SIGNAL, RETRO-200 FPS)

This rocket-powered pyrotechnical signal, figure A-13, is retrofired at 200 fps from patrol aircraft to mark

a target. Firing of the rocket initiates the delay firing mechanism of the drift signal.

After the rocket motor propellant burns out, the motor is jettisoned from the signal by action of a spring and the signal falls into the sea. The delay firing mechanism activates the signal.

A-9.1 DESCRIPTION. The 1.25-Inch Rocket Motor Mk 3 all Mods has a single nozzle and a cylindrical, radially perforated, propellant grain. A desiccant bag is assembled in the nozzle and secured by the nozzle seal. The Mod 1 differs from the Mod 0 since the Mod 1 has an Army-Navy-type, two-prong electrical connector plug while the Mod 0 has a standard household-type, two-prong electrical connector plug.

The connector assembly of the rocket motor joins the motor to the drift signal, initiates the drift signal, and jettisons the motor when the rocket propellant has burned out. The connector assembly consists of a cap, sleeve, spring, shear pin and safety pin, figure A-13. The cap has female threads at one end which mate with male threads in the rocket motor tube. At the other end, a shaft is held in the sleeve by the safety and shear pins. The sleeve has male threads which secure it to the drift signal.

When the safety pin has been removed and the rocket fired, the shaft in the connector assembly is driven toward the signal, breaking the shear pin. This compresses the connector spring; it also overcomes the spring under the firing pin in the signal. The firing pin is driven into the primer of the signal, initiating the delay fuze.

Mark	16
Mod (Mods differ only in the electrical connector)	0 and 1
General Arrangement	389040
List of Drawings	108812
Nominal Weight (lb)	4.55
Overall Length (in.)	30.45
Night Drift Signal, AN-Mk-Mod	5-4
General Arrangement	982534
List of Drawings	256089
Weight (lb) (approx)	3
Delay (sec)	8 to 12
Burning Time (min) (approx)	12
Smoke Color	White
Motor, 1.25-Inch, Mk-Mod (Mods differ only in the electrical connector.)	3-0 and 1
Loading Assembly No.	388832
List of Drawings	108665
Lot No. Prefix:	
Mod 0	RMAC
Mod 1	RMAG
Nominal Weight Shipped (lb)	1.55
Nominal Weight Fired (lb)	1.55
Thrust (lb)	200
Overall Shipping Length (in.)	11.34
Length Without Details (in.)	11.34
Burning Time (sec)	0.15
Propellant Grain Mk-Mod	5-1
Igniter Mk-Mod	105-0
Electrical Connector Type:	
Mod 0	Household
Mod 1	Army-Navy
Container Mk-Mod	3-0 or 1

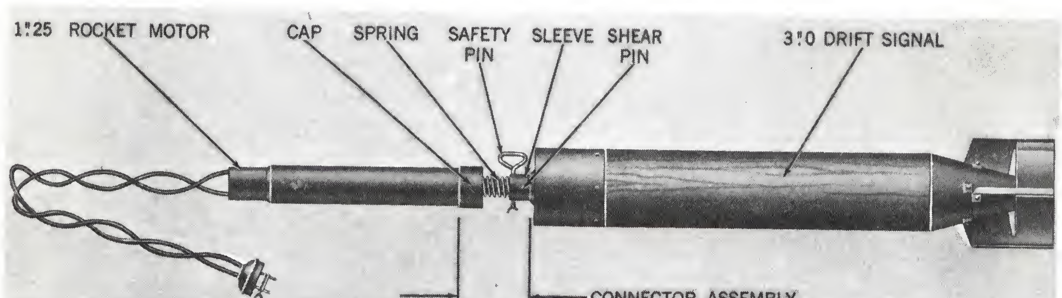


Figure A-13. 3.0-Inch Rocket Mk 16 Mod 1 (Aircraft, Night Drift Signal, RETRO-200 fps).

After the propellant burns out in the rocket motor, ending its thrust against the signal, the compressed spring of the connector pushes the cap out of the sleeve. This separates the rocket motor from the signal.

Night Drift Signal AN-Mk 5 Mod 4 produces light and smoke. The signal consists of a die-cast nose, wood body, and sheet metal tail. The nose contains a spring-held firing pin and a primer. The body is a wood cylinder with a hole in the center, in which are three pyrotechnic pellets in a moistureproof tube.

A delay fuze connects the primer, through a hole in the center of the pyrotechnic pellets, to the firstfire quickmatch at the tail end of the signal. A capped hole leads from the pyrotechnic pellets to the tail end.

When the rocket is fired, the cap of the connector assembly is driven against the firing pin. The firing pin initiates the primer which, in turn, initiates the delay fuze. The delay fuze burns for 8 to 12 seconds before it ignites the firstfire quickmatch.

Burning of the quickmatch ignites the pyrotechnic pellets. The increase in pressure inside the signal blows the cap from the tail opening, allowing the flame and smoke to flow from the signal. The signal floats tail-end up.

A-9.2 ASSEMBLY PROCEDURES. In assembling this rocket, proceed as follows:

1. Screw motor tube into female threads of connector assembly cap.

2. Unscrew retaining nut from nose of drift signal and remove sealing disc. Do not touch firing pin.

3. Screw assembled rocket motor and connector into head of drift signal. Do not remove safety pin or shear pin of connector.

A-9.3 DISASSEMBLY PROCEDURES. In disassembling this rocket, proceed as follows:

1. See that short-circuiting wire is in place on plug of electrical connector.

2. Be sure that safety pin and shear pin are in place on plug of electrical connector.

3. Unscrew connector sleeve from head of drift signal.

4. Replace sealing disc in cavity of signal.

5. Replace retaining nut on nose of signal and return signal to its container.

6. Unscrew cap of connector assembly fron nose of rocket motor.

7. Return rocket motor and connector assembly to containers.

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